RADIO and ELECTRICAL Review

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AUG. 1—SEPT. 1, 1961

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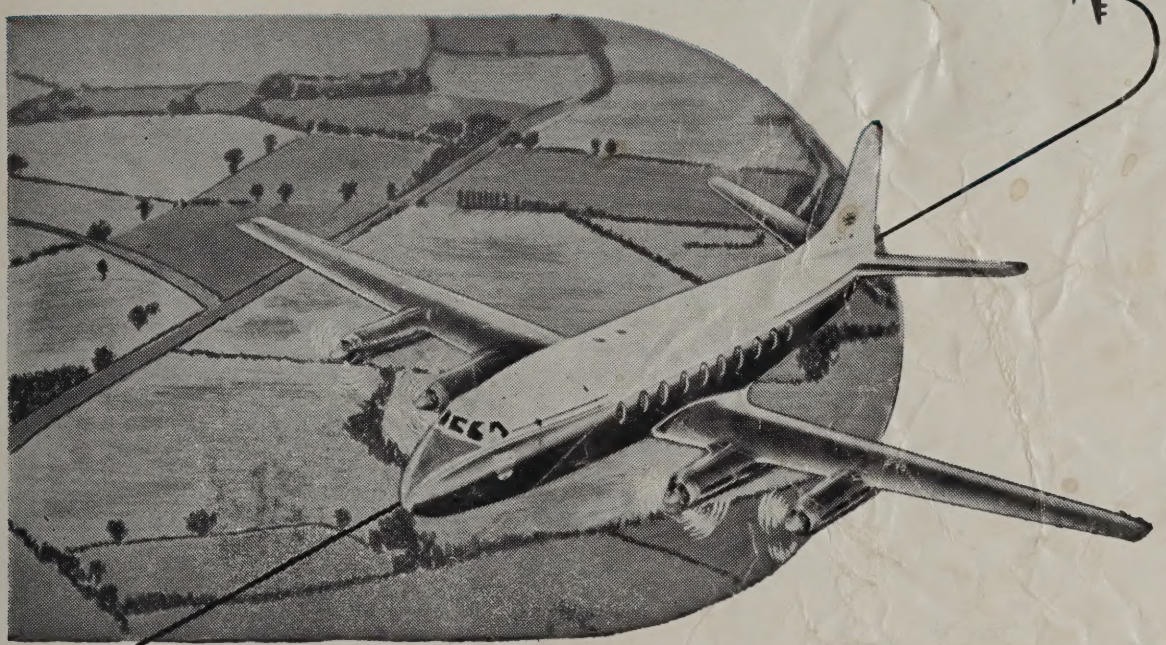

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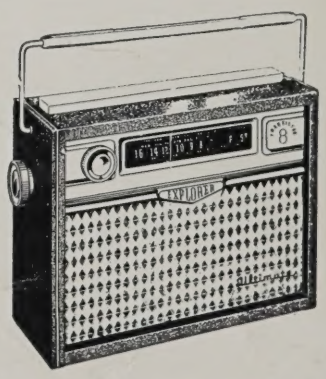

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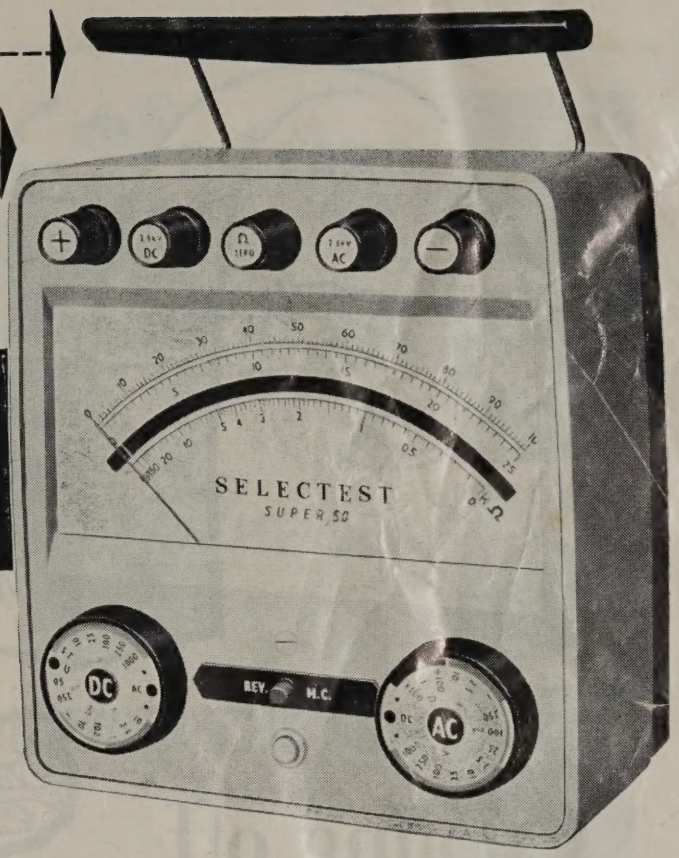

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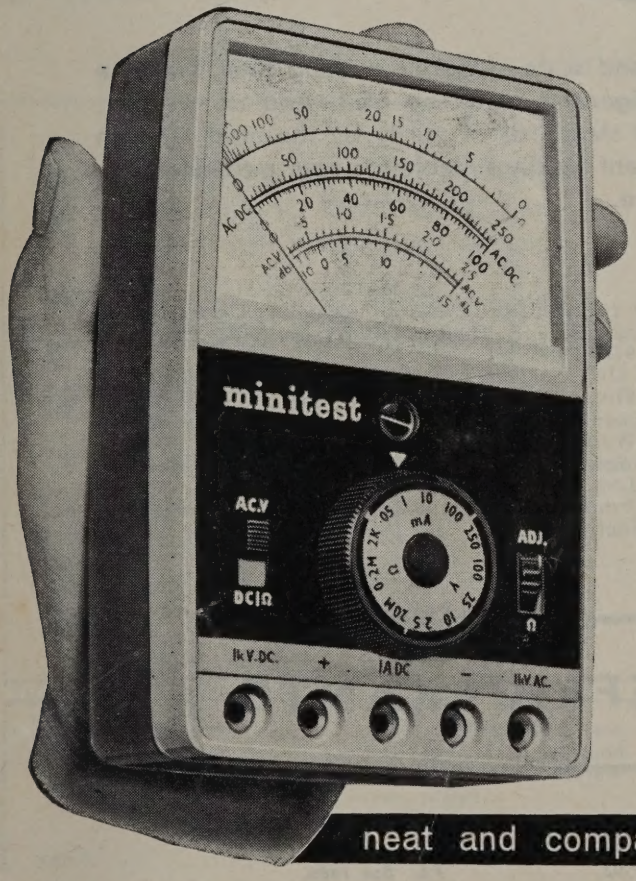

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Notice to Readers . . .

Due to the change of ownership of Radio and Electrical Review earlier this year and subsequent reorganisation, publishing in recent months has unfortunately been late.

Rather than attempt to jam in several issues before the end of the year, it has been decided to combine the August and September issues.

To make up for the missed issue it is proposed to publish a special number in the New Year. This means that subscribers will still receive the full number of issues covered by their subscriptions.

We trust that this will meet with the approval of our readers.

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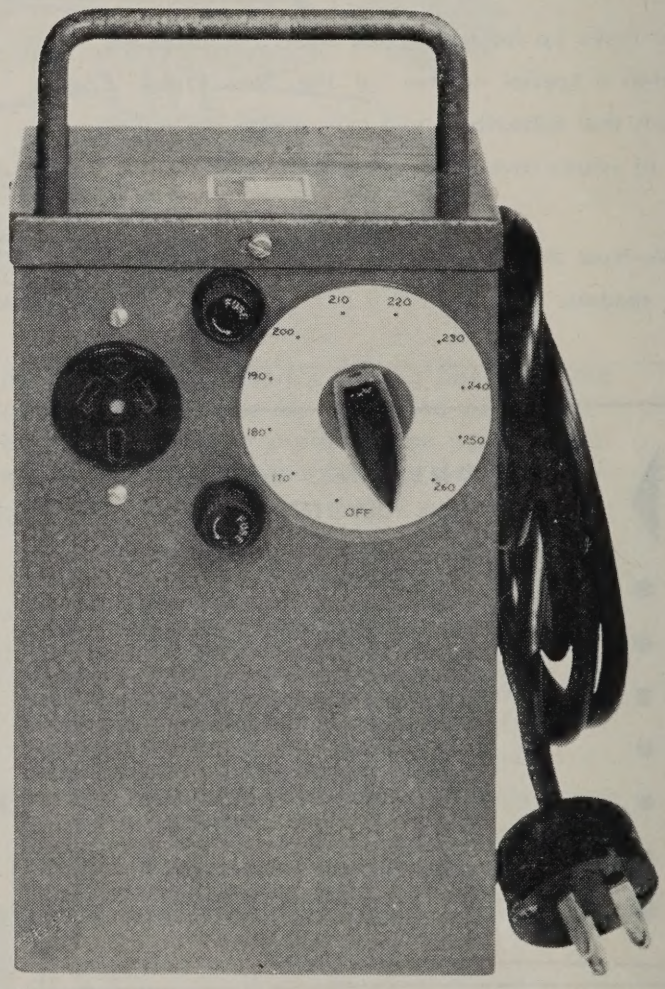

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COMING NEXT MONTH

- For the Ham—Theoretical Design of Class C Amplifiers.

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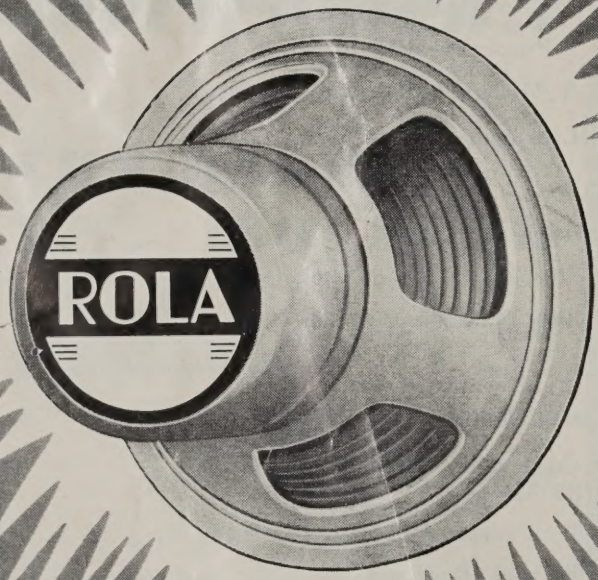

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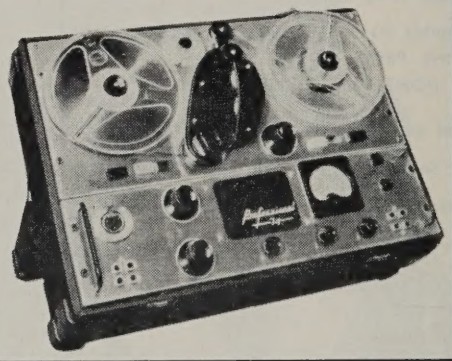

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Staffing the Industry—A National Problem

The recent announcement by the Civil Aviation Administration that they have insufficient staff to man some of their navigational aids at Rongotai for the full 24 hours, highlights a problem which has become serious over the last twelve months with the advent of television: the shortage of trained and technical electronics staff.

As we approach the end of another school year, the electronic industry as a whole should give careful consideration to the means at its disposal for attracting students leaving the various schools, colleges and Universities, and looking for their future professions and careers, to join one of this country's fastest expanding fields. Every opportunity should be taken to persuade these people that electronics is a profession worthy of, and demanding, their respect and attention.

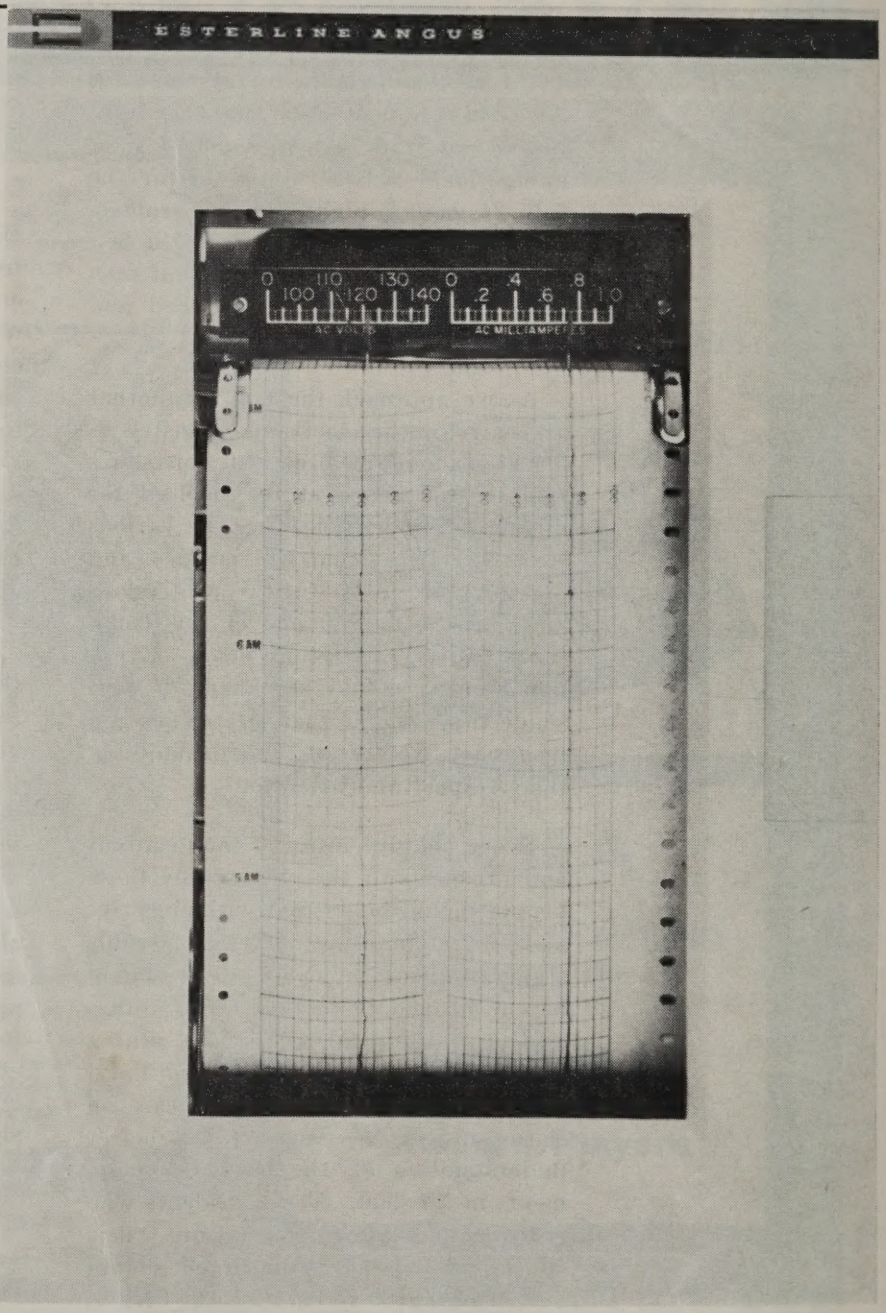
Every enquiry into the ramifications and prospects of the industry by these people should be treated with sincerity and understanding. Where possible students about to leave school should be encouraged to further their studies at Universities and technical training centres such as the Auckland Polytechnic, with particular emphasis on those subjects necessary for a better understanding of the latest developments in the field. Those students who either cannot afford to continue their studies or are not so inclined should be encouraged to attend the Night School Classes in the particular fields where they are best suited or interested in. Any tendency towards hobbies with an electronic leaning should be encouraged. This may require tolerance and understanding on the part of the employers, some of whom may doubt whether such consideration will be worth while.

The point we are attempting to make is that an interest in the electronic industry must be created, and once created, this interest must be sustained and fostered. Otherwise this country is undoubtedly going to be so short of trained and technical staff in the next few years that a lot of our technical advances will be still-born, never proceeding further than the drawing board, and not due to a singular lack of brains to conceive, but lack of personnel to carry out the work.

Another point worthy of study is that once these people have found their feet in the industry they should be given further encouragement. One of the best ways of doing this is to delegate adequate responsibility and offer incentives for those who are prepared to study. Qualifications and ability do not seem to command the respect in the electronics industry that they do in some other professions, yet a studied and qualified electronic engineer has had as hard a road to success and as comprehensive an education as an engineer, architect or lawyer and should be looked up to in the same way.

There is much that can be done to ensure that the electronic industry will be able to expand to meet the increasing demands which will be made on it. With the advent of the need for specialisation, which will tend to take men of vast general experience out of circulation, others of the rising generation must be trained to take their place.

New "602" Two-channel ESTERLINE ANGUS Recorder



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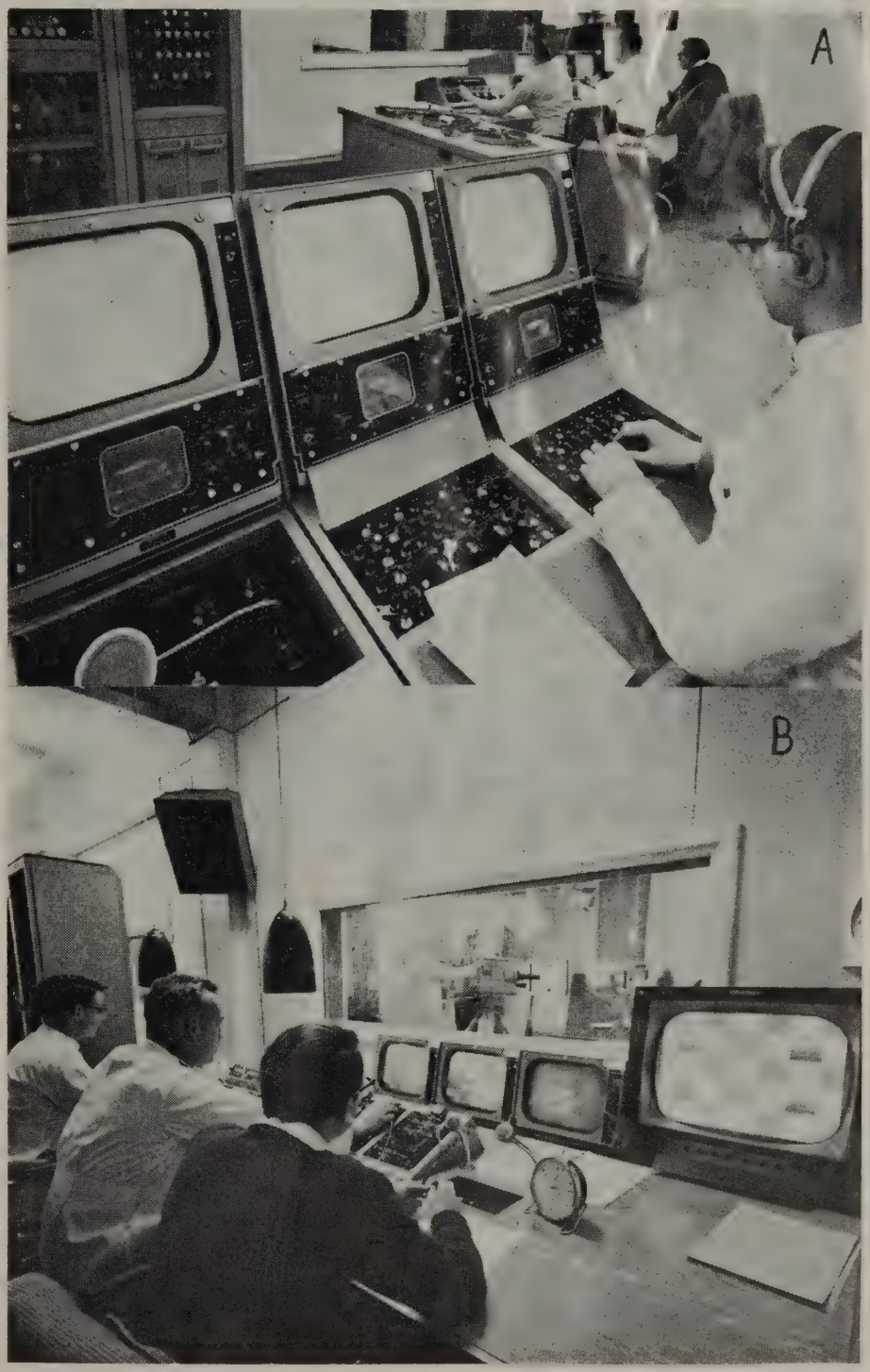
STEPPING STONES TO TELEVISION

THE dream of some day being able to "look over the hills and far away" had been the vision of physicists and scientists for ages past, but the problems in accomplishment, like those of interstellar space only a decade ago, seemed almost insurmountable—yet when we switch on television receivers in our homes, miracles of yesterday become accepted principles of today.

Only sixty-five years ago a small band of enthusiasts grappled with the subject of electromagnetic waves, when its practical use was questioned by many and even its future doubted. In 1897 Marconi demonstrated and proved that signals could be transmitted without wires. Communication was successfully established over a distance of nine miles, which constituted a record at that date. Marconi was convinced that the earth's curvature would prove no barrier and that signals could be transmitted over considerable distances. In 1901 he succeeded in bridging the Atlantic by radio. This convincing experiment demonstrated a useful practical application, and thereafter shipping companies began to show an interest in the possibilities of this amazing invention and the world's first wireless company, Marconi's Wireless Telegraph Co. Ltd., which still bears the same illustrious name, commenced in earnest the manufacture of radio equipment for ships. By 1907 radio equipment had been fitted to 139 ships and by 1913 this number had grown to 686.

Photos by courtesy of A.W.A.



A—CONCENTRATION

Skilled fingers, teamwork, and electronic equipment engineered by Marconi's, combine to achieve technical leadership for New Zealand in television. The picture shows camera control equipment manufactured by Marconi's of England and supplied by their New Zealand associates, Amalgamated Wireless (Australasia) N.Z. Limited.

B—UNDER CONTROL

Individual skill, teamwork, and Marconi electronic equipment rigidly controlling million upon million of electrons, work in unison to produce a television picture at N.Z.B.S. Channel 3, Christchurch. The view is from the master control room looking into the main studio, where two Marconi cameras are in use. The pictures from each camera can be seen on the control room monitors.

Upon the outbreak of the First World War in 1914, wireless quickly proved its vital strategic importance in naval warfare and equipment specially designed for fitment in aeroplanes was soon aloft in military aircraft, particularly those on reconnaissance. Some notable developments took place during this period of hostilities. In 1916 voice communication became possible. Hitherto the telegraphic method was used. The principle of direction finding by radio was put to practical use during the First World War. A chain of direction finding stations was established along the east coast of England and Scotland. These stations were able to take cross bearings on the enemy fleet and submarines and locate the source of signals with considerable accuracy. And so, when at last the war came to an end in 1918, much valuable technical information and experience became available to peaceful pursuits.

A giant stride in the development of commercial communications was made when Marconi's of England and Amalgamated Wireless in Australia in a joint experiment in 1921 demonstrated that direct communication between England and Australia was practicable. On this occasion the first press message was sent to Australia direct from England by wireless. The art rapidly developed and land communication stations were established in many lands, thus shrinking time and distance.

Imaginative minds were now applying themselves to a challenging new application for wireless waves—the transmission of speech and music. What greater thrill could there be than to hear through headphones, miles from the concert hall, the clear, sustained and trilling voice of Dame Nellie Melba. During the 1920s entertainment by radio swept many countries, particularly the U.S.A., like a forest fire and radio began its boom.

As though by chain reaction the science continued to broaden. Some research workers had become absorbed with the possibility of transmitting pictures. In England Baird in 1929 demonstrated the principle of television, using a system which employed 30 scanning lines and 12½ frames. In America Professor Zworykin of R.C.A. had been working on the kinescope for receiving reproduction and the iconoscope for a camera pickup tube. His achievements completed the conversion of the previously limited mechanical television to an all electronic system. Thus the science had been placed on a solid foundation upon which it was to grow soundly and securely into the future.

In 1932 an interesting experiment was conducted jointly by Marconi's and A.W.A. when the first radio picture, on a wavelength of 25 metres, was transmitted between England and Australia.

The B.B.C. in England was the first to inaugurate a television service. The first regular transmissions were from Alexandra Palace in 1937. The standard adopted was 405 interlaced lines per picture, 50 frames per second. Following this America introduced a public television service and the system adopted in the U.S.A. was 525 interlaced lines, 60 frames.

As in the first war, so in the second, without stint or reservation, all the accumulated wealth of equipment, all man's ingenuity, productive power and experience, were offered to the fighting services. At a time when it appeared that only some miracle could resist the onslaught of our enemies Radar, which enabled our forces to see the enemy without being seen themselves, came to our rescue. The experience gained on radar, which uses many techniques closely related to television, was to assist in the subsequent development of television.

Following the war improvements and refinements in television transmitting and receiving equipments were rapid. By 1950 an international standard for television had been agreed and thereafter uncommitted countries adopting this new medium followed this standard, which works on 625 interlaced lines, 50 frames. Country after country introduced

ONE LOOKS — THE OTHER LISTENS

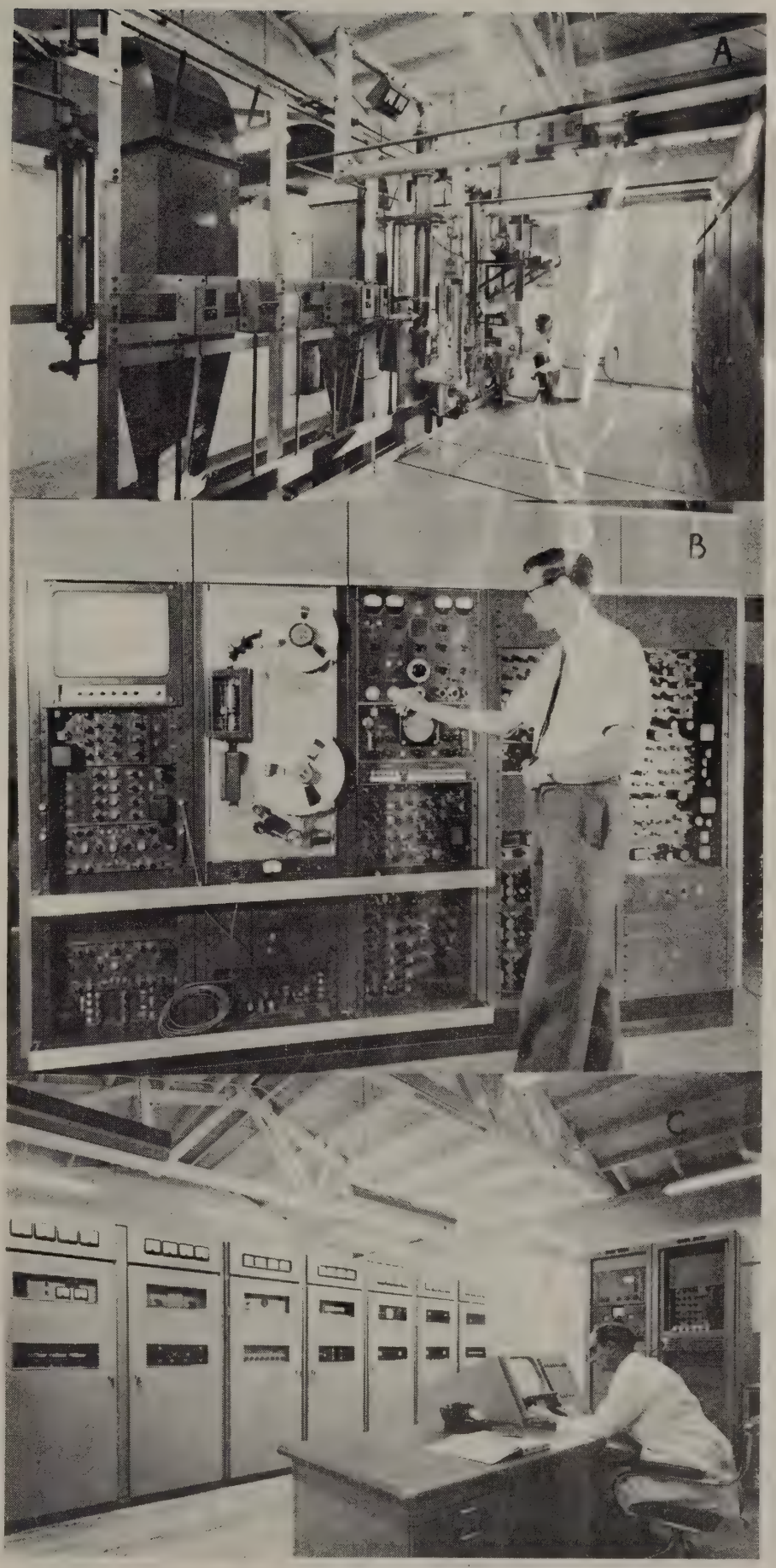
The microphone, suspended from the ceiling, eavesdrops on the conversation, and the cameras watch for every expression—every change of light and shade. Thus a television studio scene is recreated for transmission to Christchurch viewers of N.Z.B.S. Channel 3.

television until today only a few remain outside the television club.

The most significant changes which have taken place in the art during the last decade are in picture quality. Only a few years ago no one was surprised to see poor picture quality. Black halo, background graininess, white edges and "ghosting" were all accepted in varying degrees as necessary evils. A major improvement resulted when Marconi's introduced the 4½in. image orthicon camera. This gave a better signal to noise ratio, resolution and contrast range, which stated simply means that the picture is more photographic in quality.

From 1950 onwards a number of companies and technical colleges participated in television demonstrations in New Zealand in one form or another. There is no doubt that these early displays of television aroused public interest and paved the way to the introduction of our most advanced television system. In 1959 the N.Z.B.S. established its experi-

(Please turn to Page 27)



A—SERMONS IN STONES—PICTURES IN STEEL
Although looking more like a ship's engine room than electronic equipment, this is actually a view of part of a television transmitter. It is through this complex of steel that the picture and sound signals of Christchurch Channel 3 television programmes pass en route to the aerial. It is here that these signals are combined, filtered, shaped and matched in electro-mechanical components built by craftsmen and engineered to perfection.

B—Mr. P. Sandlant, Engineer-in-Charge of N.Z.B.S. Television Station, Channel 2, Auckland, checks the performance of the R.C.A. Television Tape Recorder. The finest recording facilities are available to the New Zealand Broadcasting Service in a two-machine R.C.A. television tape system, which enables duplicate tapes to be produced.

C—THE POWER BEHIND THE SCENE
Assuming perfect reception facilities, the quality of the television pictures received by the viewer depends upon the excellence of the transmitted signals. This means that any degradation in the quality of transmission would be suffered by the multitude of viewers. Because so many viewers are dependent on the television station, therefore, there can be no compromise in the quality standards at this source. The picture shows the Marconi transmitting equipment in operation in N.Z.B.S. television station, Channel 3, Christchurch.

A COMPANION RECEIVER FOR THE MOBILE TRANSMITTER

by Irving H. Spackman

This receiver was born from an idea to attempt to get the best performance with the smallest practical size and the least drain on the car battery.

One of the features of this receiver which will no doubt find favour is that the receiver covers the broadcast band, providing a source of family entertainment as well as the 160 and 80 metre amateur bands, the light aircraft air-to-ground frequencies and the small boat and coastal marine frequencies. The tuning range on the higher frequency band which is 1.6 to 4.0 mc/s is also sufficient for coverage of any other amateur channel up to and including the VHF bands by using an external converter with the receiver.

The "front-end" of the receiver is admirably catered for by using the "Inductance Specialists" Type 114AW Coil Assembly. This unit is wired, tested and prealigned complete with tubes. The only additional work on this section is modification to the filament string for 6 volt operation, modification of the aerial input to permit the use of low and high impedance connections, connection of front panel antenna trimmers, and slight adjustment to the A.V.C. line to provide better weak signal sensitivity, more control of fading signals, and to alleviate overloading and cross-modulation when working near other powerful transmitting equipment.

In conjunction with the circuit supplied with the unit, the modifications as listed here, and shown in the circuit of the antenna stage and RF amplifier are easily carried out. The changes are:—

1. Remove the leads to the coils L1 and L2 from the 2 pillar type 2-20 pf Trimmers C4 and C5.
2. Remove the 10 megohm resistor between HT and AVC line, R2.
3. Remove screen to ground resistor R3 and replace with 2.7 K ½ watt resistor.
4. Remove C35 and replace with 0.1 mfd paper.
5. Change the series filament connection for 6 volt operation to parallel connection.

Construction

The receiver was constructed, with the exception of the transistor output audio stage, on an aluminium chassis 5in. x 7in. x 2in. deep used with the narrow side to the front. The front panel was a piece of good quality aluminium sheet 18 G, 6in. wide x 5½in. high, fixed to the front of the chassis with 6 BA. bolts and nuts and the mounting nuts of some of the components. A slot was cut in the top left hand side of the chassis to accommodate the 114 AW unit mounting up from underneath, with a ⅜in. hole in the front to pass the shaft of the band-switch.

The 3-gang 40-440 pf variable condenser should be a compact type, preferably dust protected with sturdy plates to prevent frequency shift due to vibration. This should be mounted to the right of the coil unit on the feet provided so that it matches up with a small 5:1 reduction ratio planetary type dial about 3in. diameter with a 0-100 scale. This type of dial mounts in front of the panel with 3 screws, with the boss for the ¼in. shaft protruding through a hole in the panel.

The 2 IF transformers and the IF amplifier tube were arranged conveniently in the area to the rear of the tuning condenser with the 1st IF transformer adjacent to the ECH83 mixer tube in the 114 AW unit.

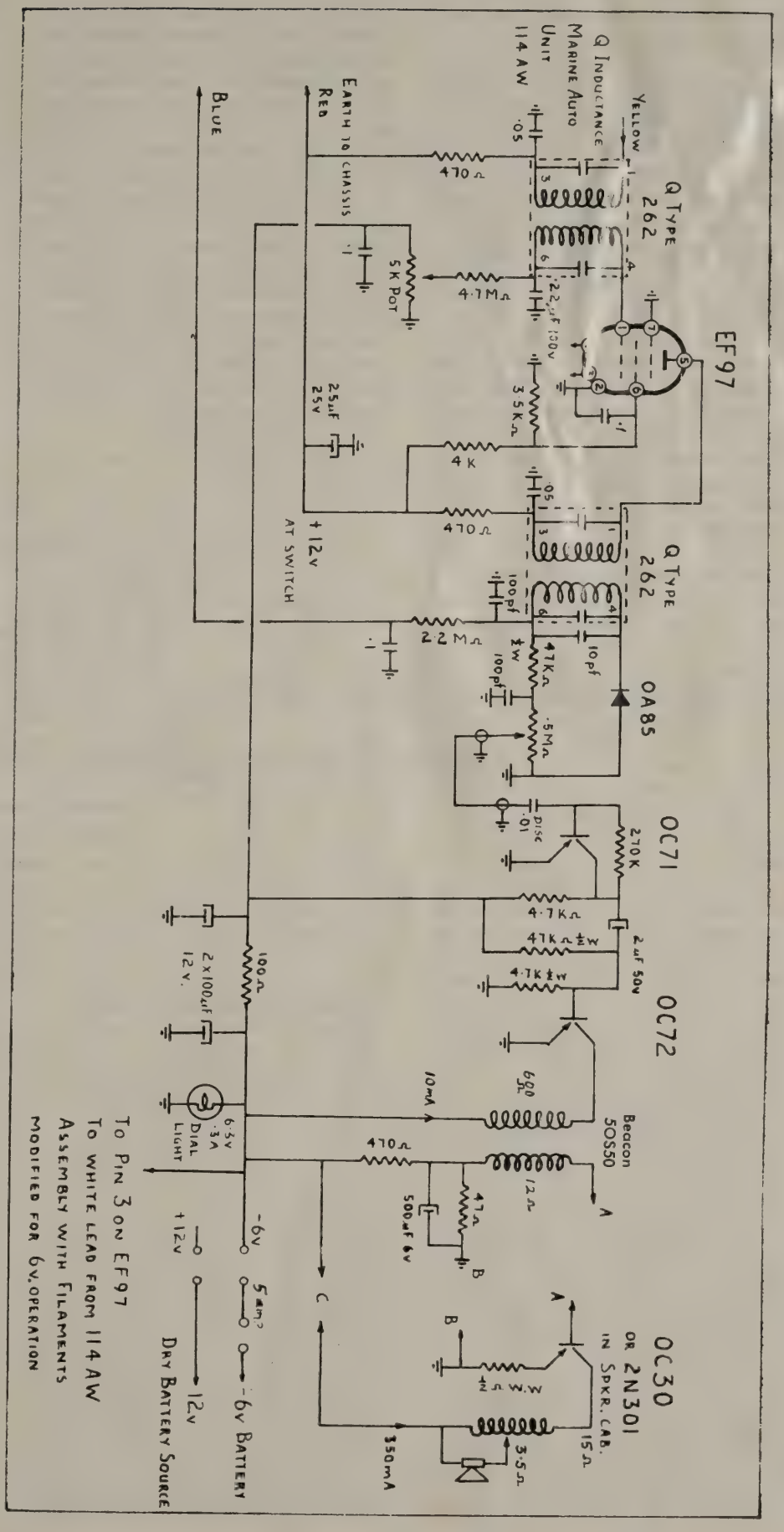
For several reasons, it was decided to place the output transformer and the output power transistor in the speaker box, which also housed a 5in. P.M. speaker. Such a speaker was selected because it seemed to give the best all round performance, with adequate sound level for use in the car whilst in motion, and still retaining good quality when reproducing the broadcast programmes. The output transistor which was mounted on the prescribed heat sink together with the output auto-transformer were mounted on the base of the speaker box and only required a 3-wire cable to connect the sub unit to the main chassis. All the components associated with the output transistor were mounted on a 4-way tag panel held under one of the mounting screws for the auto-transformer. Mounting the output transformer in the speaker box eliminates any problem with heat from other valves etc., whilst the final valid reason for mounting the transistor in the speaker cabinet is that there is not sufficient room for it and its associated transformer on the chassis.

To the left of the main tuning dial on the front panel and immediately over the antenna coils in the 114 AW unit, a 25 pf air spaced shaft-type midget variable was mounted. This was wired across the 1st section of the 3-gang condenser. This trimmer was deemed necessary as it was intended to use the receiver with

various antenna inputs, and front panel trimming of the aerial circuit seemed necessary to achieve best performance due to the high Q of the antenna and the aerial coils in the 114AW unit. To the right of the bandswitch was mounted the 5K ohm IF gain control with its associated double pole on-off switch to switch the 6v filament and 12v anode supply. On the extreme righthand side under the dial the ½ megohm volume control was mounted. There is also room for 2 toggle switches, one a single pole-single throw whilst the other is a double pole single throw. The first switch can be used for switching in a simple series diode noise limiter whilst the second can switch on a transistorised BFO and earth the AVC. line at the same time to prevent the BFO voltage from desensitising the receiver. These were not, however, included in the original receiver and are not shown on the circuit. There is room in the region underneath the chassis where the tuning gang is located to accommodate an IF type transistor and coil should a BFO be desired.

All wired components such as resistors, condensers, the leads on IF transformers, transistors and diodes should be terminated on tag panels mounted in suitable locations. Any component on long leads supported in mid air will not last very long in mobile equipment. When soldering the transistors and diode into circuit, a pair of thin nosed pliers should be used to grip the wire between the joint and the component to act as a heat sink. Also it is suggested that this type of component be connected after all other wiring has finished in order that they are not subjected to excess heat.

The layout around the IF stage should be neat with all wires short and direct. This stage is quite "hot" in performance, and proper attention to shielding and



I.F. and Audio Section of Mobile Receiver.

by-passes will reduce any tendency to instability.

The transistor audio section provides adequate gain with very low drain on the battery. The standing current of the audio output transistor should be adjusted with the base bias network resistors to comply with the manufacturer's rated figure and checked after intervals of an hour or so to see that there is no likelihood of thermal runaway. Any of the suggested output transistors will deliver a watt or more of good quality audio, and this output into the 5in. speaker should be sufficient to overcome wind noise and car noise incurred whilst travelling.

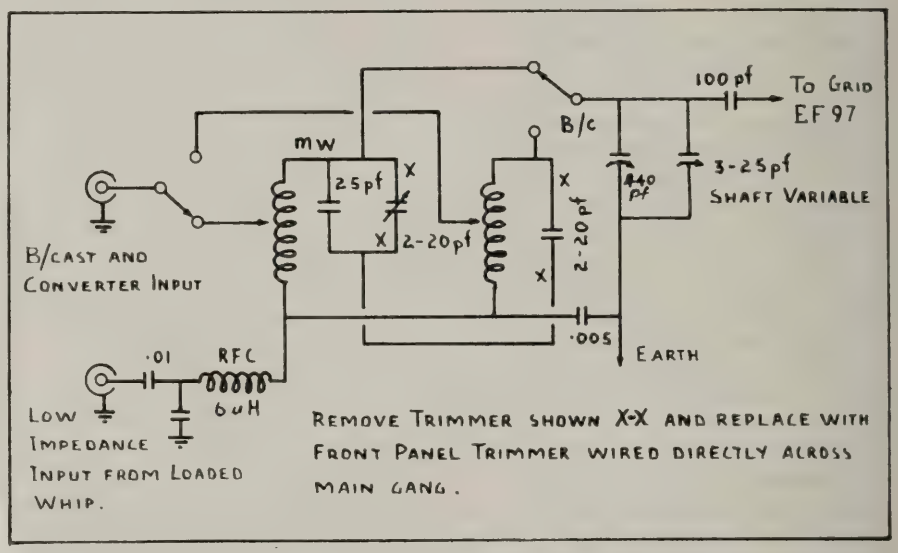
It will be noticed that 12v. D.C. from a separate battery supply is used to feed the anodes and screens of the tube section of the receiver, while the filaments, negative bias, and transistors are fed from the 6v. battery system. The existing series connected filament chain in the 114 AW unit needs to be modified for 6v. operation. For 12v. operation the filament chain is retained intact and a 12-volt heater type tube replaces the EF97. A suggested type is the 12BL6 with corresponding slight changes in the screen circuitry and connections. There will be little difference in performance, however. The transistors will also operate successfully on 12 volts with the exception of the output stage which will need changes in the output auto-transformer and driver transformer, and forward bias network.

The 12 volt battery pack mentioned above has a life of more than a year. The reason for its use is that even with a positive earth battery system in the car, normal conventional wiring can be used throughout the tube section with all cathodes earthed. The positive earth battery system however is ideal for P.N.P. transistor equipment as all emitters can be returned to earth. (Check your own car carefully).

As far as the filaments are concerned battery polarity is of little importance. If some other polarity is used the bias control for IF gain may have to be changed however. The battery supply used by the author was three 4.5v. cycle lamp batteries wired in series and stowed in the back of the speaker box. The 13.5 volts allows a wide margin of voltage drop due to age and usage before performance of the receiver becomes impaired. The tube section will operate with H.T. voltage down to about 8 volts, but sensitivity and overload characteristics are impaired.

and then check the tracking on the low frequency end. Repeat the operation for final touch up of all trimmers.

On the high frequency band tune to a point about 10 degrees from the high frequency end and align oscillator and RF trimmers to bring in a signal on 4.0 mc/s from a crystal spotter, V.F.O. or signal generator. Then check the tracking and tuning range. 1.6 mc/s should be nearly full capacity on the gang. Repeat the process for final touch up. If any adjustment is required, carefully adjust the correct padding con-



Modification to Input Circuit of Type 114 AW Unit to provide independent RF Trimmer and A.V.C. modification.

Alignment of the Completed Receiver

Although the 114 AW unit has been prealigned, a small amount of touching up is necessary to compensate for the variations in wiring, variable condenser characteristics, etc., also the IF frequency used.

First, align the IF stage with a signal generator or tune to one of the local broadcast stations to provide a signal source. The A.V.C. voltage measured with a 20,000 ohm/volt or V.T.V.M. on the 10v. scale can be used as the indication of correct alignment.

Align the Broadcast band oscillator and R.F. trimmers on a station at the high frequency end

denser to bring the alignment correct. However, little alteration to the padding capacity should be needed.

Performance

On the shortwave band, particularly at the high frequency end, sensitivity is all that is desired, with even a 1 microvolt modulated signal producing useful audio output. The IF gain control provides a fixed level of sensitivity which can be adjusted as required. Normally on Broadcast operation in city areas, the IF gain control is operated in the fully off condition, and the audio volume is adjusted to give comfortable listening level. On eighty metres particularly, mobile opera-

(Continued on Page 23)

electronic control & indication of level and proximity

PART 3

by C. W. Salmon

IN earlier articles stress has been laid on ease of installation and maintenance being of prime importance when electronic equipment is being considered for industrial applications. Of almost equal importance is the need for the designer and manufacturer of such equipment to take into consideration the widest range of possible installations and applications. Variety reduction and minimum "stock units" are two very real ideas in industrial management and any manufacturer who can offer a single basic instrument capable of dealing with a number of similar problems has much in his favour. This article describes a local installation of the level indicator and how some particular problems were overcome. The concluding sections deal with instruments of a more special nature but still depending upon change of capacity.

A Local Level Indicatar Installation

The installation to be described is situated at a bitumen handling plant in the Waikato and has been in successful operation for some 18 months with freedom from maintenance or service calls to date. The basic problem was that of indicating at a remote point the contents of a hot bitumen tank of some 10 feet diameter and about 30 feet high. The principal problem was the temperature of the material as this is usually 300°F or so. Whilst this could have been a disadvantage, bitumen, being an insulator, meant that a bare electrode was in order so that no electrode sheath was required. After consideration of the length of electrode involved it was felt that a reasonably rigid rod would be required and that it would need to be supported at the bottom of the tank so as to prevent sideways sway due to swirling of the bitumen during emptying or filling of the storage tank. ⅜-inch diameter galvanised conduit was chosen as the cheapest consistent with reasonable mechanical strength. A further point in favour of using conduit was that should the existing electrode be broken during cleaning or similar work inside the storage tank, replacement would be an easy matter that could be carried out by the Company's electrician in a routine manner. The electrode was installed about three feet out from the wall of the tank so that it would not be too close to the earthed tank wall for two reasons. The first being to obtain a good dielectric increase with the rise of the bitumen as an electrode installed too close to an earthed container wall will not exhibit so great a capacity change as one further away—taking this to an extreme it will be seen that an electrode placed a fraction of an inch away from its earth will already have a fairly high "standing" capacity and any increase in capacity due to a rise of the dielectric will not be so great a change as otherwise. The second reason for placing the electrode well away from the walls was that should the bottom electrode holder break then it would be unlikely for the electrode to swing 3 feet or so onto the wall and short itself out.

The electrode was supported at the top of the tank by a porcelain insulator and the conduit was prevented from dropping through by a retaining ring clamped onto it. This whole top assembly is housed in a weatherproof cast aluminium "hat" bolted down to the tank top with provision for the coaxial cable to feed out to the unit proper. The bottom retaining porcelain was clamped in an inverted position at the tank bottom and the ⅜-inch conduit loosely held by about an inch of the porcelain body. Sufficient gap was left for downwards expansion of the conduit after the tank was filled with the hot bitumen.

From figures and charts supplied by the manufacturers the approximate "empty" and "full" capacitance values of the tank were known so that dummy setting up tests were possible before the tank was filled for the first time. To obtain best accuracy from the type of instrument under consideration a short connection between the electrode head and the instrument proper is to be aimed at and it is usual to limit this to five or six feet. In this installation this distance was convenient in that the adjoining pump-house is only three or four feet away. This building is the same height as the storage tank so that the coaxial cable was fed straight from the top of the tank to the instrument. In addition this building afforded some protection from rain and heat. From the instrument a single pair lead was taken to a remote indicating meter scaled for the tank capacity.

Initial setting up was done with the tank empty and the "full" capacity was made up from capacitors so that a full calibration point on the indicator could be set. The usual procedure is to adjust the indicator by means of preset controls, to zero for an empty tank, fill the tank and adjust the indicating meter to maximum by means of another preset control. This is done several times until empty and full conditions become exactly 0 and 100% of the meter deflection. It will be easy to see that handling some 10,000 gallons of bitumen to obtain this result cannot readily be done quickly. Thus, the first attempt to set the system up was done by placing about

300 pf of capacity across the electrode and making the required "full" adjustments. The slight interaction between the setting controls is usually overcome in two or three attempts of "empty" and "full" conditions.

Whilst the above installation was a simple one because the bitumen was an insulator in itself the same approach would apply to most other installations. The same electrode system could be used for a hot "conducting" material such as hot water or hot acids except that in such case the electrode would have to be insulated with a temperature resisting material such as a PTFE plastic or pyrex glass. As it was initial problems were encountered with the high temperatures of the tank. Quite soon after the first runs it was noticed that irregular readings were obtained. This was found to be caused by bitumen vapour coming up the centre of the conduit into the protecting "hat" and condensing. This cycle of evaporation and condensation occurred several times and carried over enough bitumen to eventually eat away the polythene insulator of the coaxial cable inside the "hat." This was cured quite simply by blocking the top of the conduit. A similar problem was caused by conduction of heat by the conduit when the tank level was high through into the protecting "hat" and slowly melting the polythene insulation of the central conductor. This was prevented by baring back the central conductor as much as possible. No further trouble has been experienced on this score.

Mention was made above of the need for a short lead from the electrode head to the instrument but this sometimes presents problems. Either it may not be mechanically possible to mount the instrument close to the electrode head due to vibration or the temperature may be too high for sustained and reliable operation. Although modified versions of the standard "Telstor" under consideration are obtainable for longer lengths of coaxial cable in some cases it is possible to combine the need for greater distance with a requirement due to some other factor such as temperature —or conversely and more likely, excess temperature will make it imperative to remove the instrument some distance. Where removal a few feet more may be done only to mechanical problems such as vibration special low capacity coaxial cable can be used and the usual six feet separation can be extended to 12 or 15 feet. However, cases have been reported where extension to this distance to keep the main unit away from excess temperature (over, say, 100°F) brings further problems. One case within the writer's knowledge occurred in an Auckland forest products factory. Wood chips were fed into a hopper to fire a boiler and simple "high level" control (not indication) was required.

This installation employed the simple capacity sensitive instrument described in an earlier article but could equally well have been the more complicated indicating unit. The problem of distance between the electrode head and the instrument proper is common to both types and identical electrode systems can be used on both and are often interchangeable. The installation mentioned above after some months service brought two difficulties to light. It was found that certain conditions could bring about small fires in the hopper through the building up of sufficient heat to ignite the wood chips. This in itself was not serious because a hopper fire of quite serious nature could never harm the building and in any case would be prevented but a small "burn-up" near the electrode which was paddle shaped and about 12 square inches in area, charred the supporting arm made up from laminated fibre tube of a grade that would withstand the usual 100°F ambient temperature. The paddle electrode was replaced with one made up on a moulded fibreglass arm. An equal alternative would be an arm of pyrex glass. Having solved the immediate problem it was thought that any future "burn-up" could have the instrument itself—by the heat from the fire caused.

Structural features necessitated the instrument being either on the hopper or at least 12 feet away. This distance could easily have been achieved with low capacity coaxial cable but the high ambient temperature would over a long period cause the polythene insulation of the cable to "flow" with a final breakdown of the central conductor to the earthed sheath. An air spaced tubular coaxial feed seemed to be the best solution and accordingly the greater distance between the electrode head and the instrument was fed in this manner. For ease ofmaintenance and installation each end of this section was fitted with a Pye corrector with a short flexible coaxial lead terminated as required. The tubular coaxial section was made up from 1-inch copper pipe of a reasonably light gauge with the centre conductor of brazing rod so as to be rigid. The centre conductor was supported every 12 inches by small discs. These discs were made up from high temperature plastic cut from $\frac{1}{4}$-inch sheet. Should a similar installation be called for again the writer would be inclined to use glazed ceramic so as to prevent any long term sag of the central conductor that could occur by its sinking into the plastic disc. Although this is unlikely in the installation under consideration because the ambient temperature is still only "tropical," another installation may be in a much hotter situation and there is no doubt that the ordinary perspexes start to flow at reasonably low temperatures. P.T.F.E. materials are available overseas but are still scarce here whereas the New Zealand pottery industry provides a wide range of electrical components. Glazed discs would be preferred so as to prevent the ingress of moisture which could upset the capacity of the coaxial tube or even cause a short circuit. The ratio of diameters was chosen to match the coaxial cable impedance of 50 ohms although it is not thought a change of impedance would materially affect operation.

Indication With Control

The logical extension to indication of contents at a remote point is control of auxiliary equipment

by the same unit. By such means pumps, fans, conveyor systems and alarms could be operated at selected points over the indicator scale. Unfortunately a robust and relatively cheap contact-making milliameter has yet to become readily available. Several American Companies manufacture contact-making meters but usually no longer than 4-inch scales. For quick observation a 6-inch scale at least is required so as to be easily visible up to 20 feet. Any smaller scale induces eye strain or errors unless it is observed at least less than 8 or 10 feet away. Many plants have control panels so positioned that the operator or foreman may be 15 or 20 feet distant from a meter dial and yet still need to be able to read the dial with reasonable accuracy.

A recent advance in contact making meters on the Continent has resulted in the availability of meters with scales of 6-inch or greater. These meters do not use the indicating needle to directly drive the contact-making arms and thus the consumption of the milliameter coil is of the usual order and 1 MA movements are available as standard items. The particular make the writer has used employs a "magnetic balance." The distant end of the pointer needle away from the scale and hidden by the scale plate has a metallic disc fitted which passes between two balance coils fed with a small voltage. So long as this disc does not intrude between the coils the control circuit is in balance. Unbalance by movement of the disc is fed into a transistorised detector operating a control relay. The two coils are mounted on an adjustable arm which can be moved over most of the quadrant of the meter so that the contact making properties extend over most of the scale. A more elaborate version of this instrument has two such adjustable arms so that "lower" and "upper" control is possible.

This solution to indication with control combined in one instrument does away with the need for separate level controls but there appears to be little difference in the cost. Nevtreheless such combined control in one instrument reduces the number of individual equipments involved and thus maintenance and spares become less of a problem. In addition a single electrode only is required. "Lower" and "upper" control by separate instruments, in addition to the indicating instrument would require two further electrodes in the container and this may be a serious mechanical advantage.

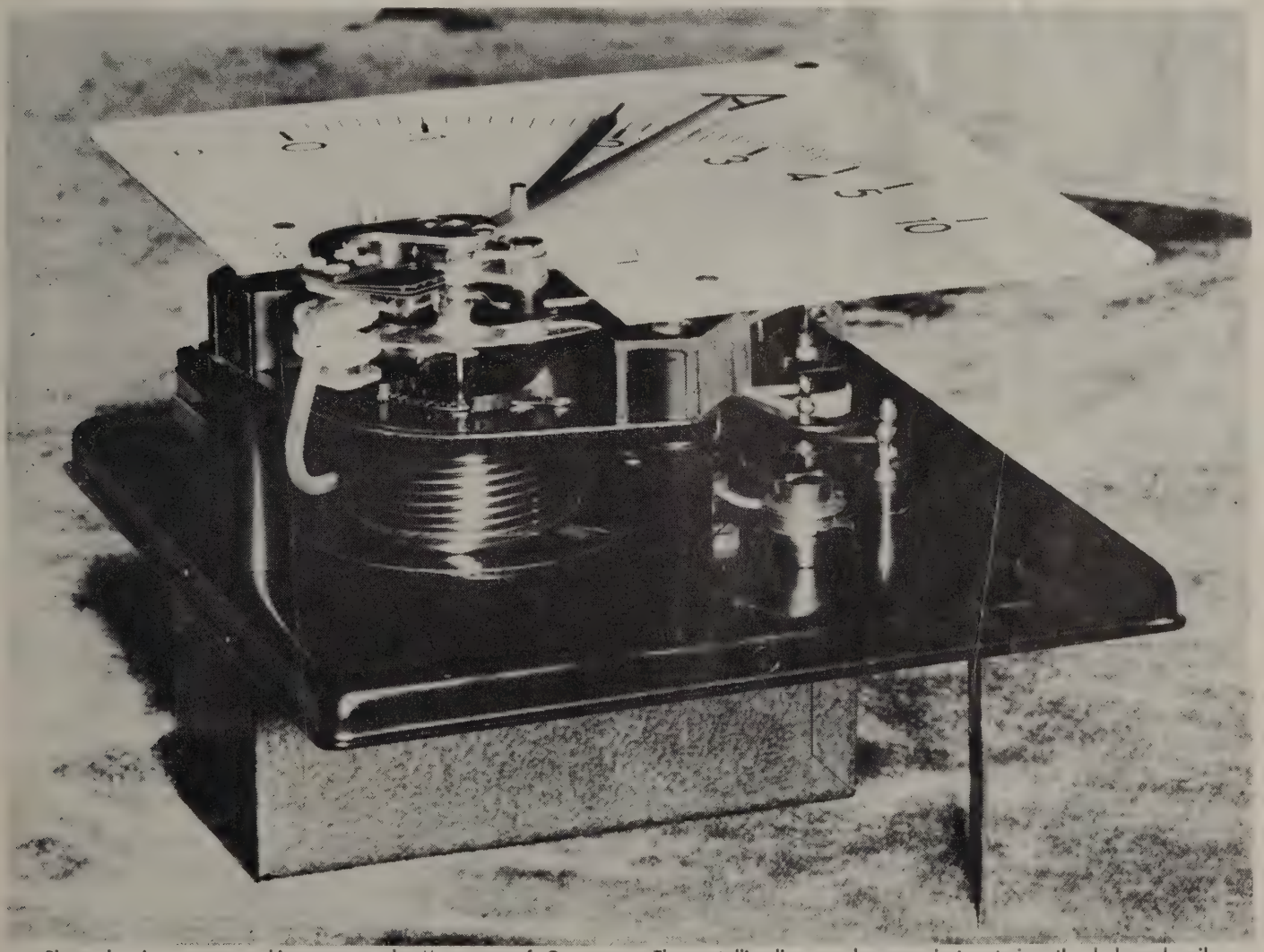


Photo showing contact making ammeter by Metrawatt of Germany. The metallic disc can be seen just entering the balanced coil system to the left of the movement. The disc is driven by the movement and the coil assembly by the externally adjustable pointer,

A MODERN LIGHT SENSITIVE RELAY

By R. J. HALL

Photos.: Jack Lang

Features:

- Cheap to construct
- Foolproof
- Simple Circuit.

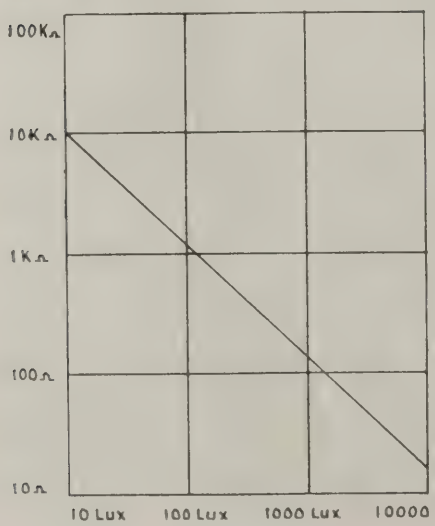
The uses of this unit are limited only by the constructor's imagination, but to help it along here are a few:

- Shop Door Minder.
- Daylight switch to switch a light on at dusk and off again at dawn.
- Flame detector for furnace flame control or as a fire detector, etc.

The circuit to be described is so sensitive that a single flame from a lighted match will trigger it from a distance of about 4 feet in a darkened room.

TOP OF PAGE. The Heart of the Unit—a Light Sensitive Resistance shown here mounted on connector strip. Photo shows unit more than twice actual size.

FIG. 1. Resistance as a function of light intensity.

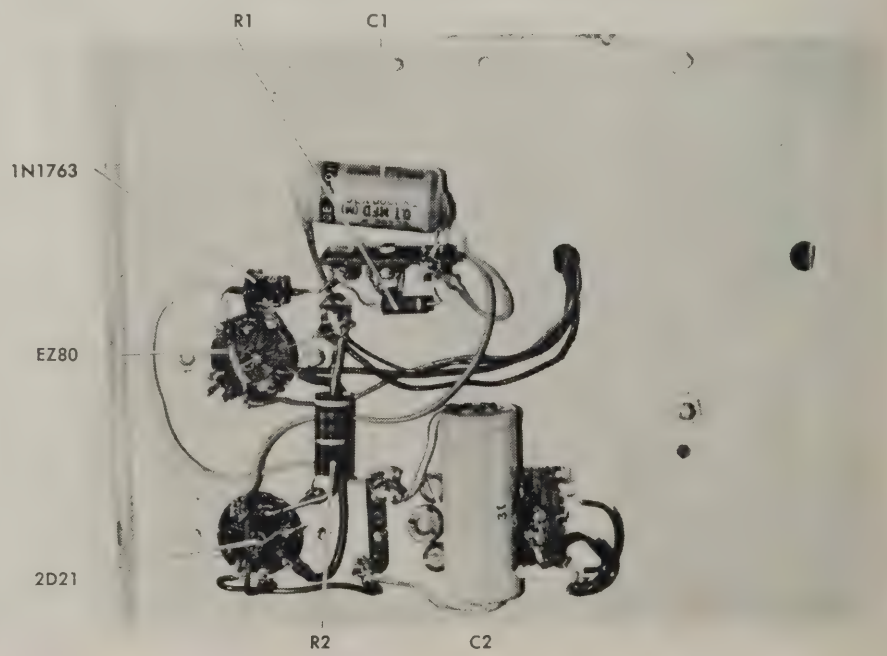


Circuit Description

The operation of this circuit is based upon the change in resistance of the resistor V.D.R. upon exposure to light. This change is shown in Fig. 1. The control tube V2 (2D21) has a negative voltage on the grid sufficient to reduce the plate current to a point where the relay RL1 is open. This negative voltage is obtained from diode D1, filtered by resistor and capacitor and applied to the grid of V2 via the potentiometer, P1 which acts as a sensitivity control. The resistor VDR acts as a grid leak the value of which changes with a change in the amount of light falling upon it.

In operation the control P1 is adjusted to a point where the relay just drops out and any increase in light will cause the grid bias on V2 to drop and allowing the plate current to rise thus pulling in the relay. The control may be adjusted until the relay just

View of under chassis wiring showing component layout.



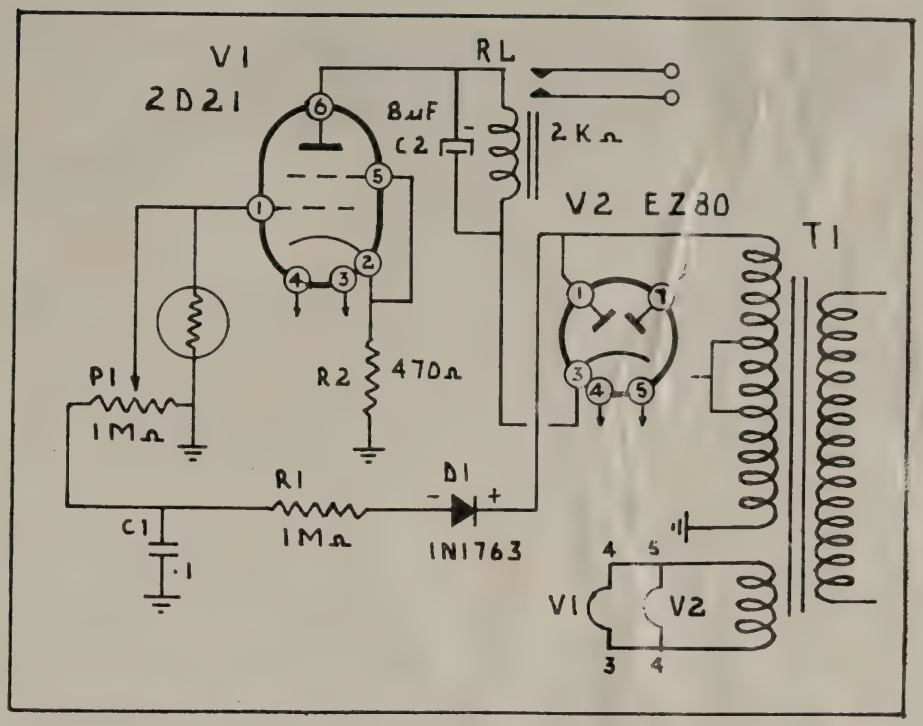
pulls in and any decrease in light will then cause the relay to drop out.

Construction

This unit may be built in almost any form that the constructor desires, the author's model being built into a case intended for another piece of equipment as you will see in the photo. If desired V1 could be replaced by a IN763 silicon diode in which case a 100 ohm 2w resistor should be inserted in series with it.

If the VDR is to be placed at a point remote from the unit it should be connected by a coaxial cable, otherwise instability may result. A suitable lens system could be made up using a jeweller's eyeglass with a focal length of about 2 inches.

These may be bought for a few shillings. When the unit is to be used as a shop door minder the light source can be a 6.3v radio dial lamp which can be connected to the filament winding of the power transformer.



Circuit Diagram of Light Sensitive Relay.

TV "Commercial Killer"

To use this unit as a "commercial killer" on a TV set the relay contacts should be arranged to short circuit the primary of the receiver output transformer when a light beam strikes the LDR. This of course should be mounted on top of the TV set. To operate it just shine a torch on to the LDR and "hey, presto," no sound.

Note.—Using the components as specified in this article the unit may be run 24 hours a day and will give a very long and useful life.

PARTS LIST

T1 — Pri. 230v; Sec. 220v 30 mA, 6.3v 1.9A (Beacon type R64)

V1 — 2D21; V2, EZ80

D1 — 1N1763 (RCA or Hughes)

C1 — .1mfd. Paper Condenser

C2 — 8 mfd Electrolytic 350v

R1 — 1 meg 1 watt Resistor

R2 — 470 ohms 2w Resistor

P1 — 1 meg Potentiometer (preset type)

LDR — Philips Light Dependent Resistor

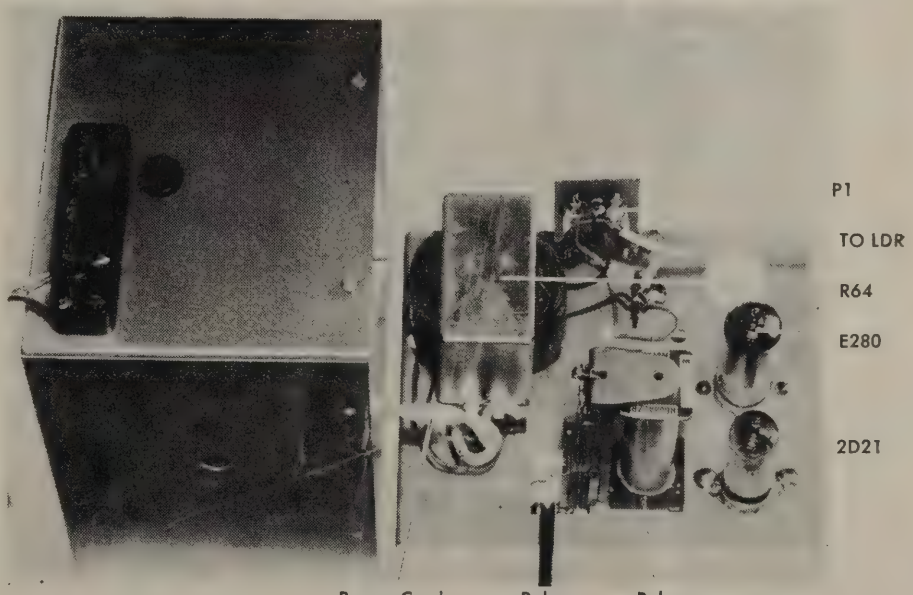
RL — 2K to 10K Type 3000 Relay or similar

2 Noval Valve Sockets

Chassis to suit

Miscellaneous Hardware.

View of top side of unit with cover removed.



LOOKING AT

ZENER DIODES

Among the many new components now appearing in electronic quipment as a result of the intensive work which has been done on semi-conductors in the last few years, is a useful group known as "Zener Diodes." What are these "Zener Diodes" and what do they do?

Silicon junction diodes are noted for their excellent reverse current characteristics The reverse current through the junction remains very small with applied voltages up to a certain value—the "Zener Voltage." When the voltage is raised even slightly above this figure, the current across the junction increases very rapidly to a new figure, many, many times higher than the original.

This phenomenon is not a breakdown in the same way that a dielectric material breaks down, but is a completely reversible process, which does not damage the junction, as long as the diode is not allowed to operate continuously in this region; under such conditions that the dissipation of the device is exceeded, when damage would surely occur.

This Zener breakdown effect occurs in silicon junctions up to an applied voltage of about 5 volts. At higher voltages breakdown is due to a mechanism called "avalanche multiplication." Thus the higher voltage "Zener Diodes" should really be called "avalanche diodes." However, apart from certain fundamental differences in action, their behaviour is so similar to the normal zener diodes, that it is convenient and quite sound to include both types under the name "Zener Diodes."

One of the great advantages of these devices which are used in a host of different applications, is that the breakdown voltage can be controlled during the manufacturing process, to lie anywhere between 2 volts and several hundred volts. The transition across the zener voltage point is generally smooth, without the need for special striking voltages or the problem of having to raise the voltage above the striking point, as is necessary with gaseous voltage regulator tubes. Another point is that there is no tendency to conditions of negative resistance, which means that shunt capacitance can be used in the associated circuitry, without a tendency to oscillation. A final point in their favour, is that Zener diodes are smaller and more robust than gas regulator tubes, or batteries, and have, in addition, a much longer expectation of life.

The characteristics of a particular voltage rated Zener diode, are not a constant fixed value. Generally speaking the voltage increases with the operating current, and consequently the current at which the voltage is measured must be specified. In many cases the manufacturer chooses a particular value of current, and quotes the voltage of a series of diodes at this current figure.

The next type of particular characteristic is the "dynamic resistance" of the diode in the Zener region. This also is measured at a given current figure, often the same as that at which the voltage measurements are made. The lower the dynamic resistance, or slope resistance, as it is sometimes called, the more constant is the operating voltage, with change in current through the diode.

The third factor to be taken into account is temperature. Along with most other kinds of semi-conductor devices, the "zener diode" is to a certain extent temperature conscious. The operating voltage at a given current, changes with ambient temperature, and consequently to be precise, the temperature or temperature co-efficient must also be given. Also as the devices are temperature conscious, they are given a maximum working temperature, and this will impose limits to the maximum continuous working dissipation of the particular diode.

Looking further into the effects of temperature on the Zener diode, we discover that the temperature co-efficient of Zener diodes with operating voltages below about 8 volts, seems to be negative; whilst the temperature co-efficient for Zener diodes with operating voltages above 8 volts or so, tends to be positive. This is attributed to the fact that the diodes working below 5 volts exhibit zener breakdown, those

working above about 8 volts exhibit the avalanche effect, and those working between 5 and 8 volts tend to exhibit a combination of the two processes.

As a means of tidying up the foregoing effects, it seems to be usual for the manufacturers to present the characteristics of a particular range of zener diodes, manufactured to the same physical dimensions, and differing only in zener voltage, in the form of a series of curves showing the various parameters plotted against the breakdown voltage, at which the particular diode operates. Looking at some of these curves shows that diodes with breakdown voltages near 5 volts, exhibit the least variation of temperature co-efficient with respect to applied voltage.

Design Problems

The manufacturer can design diodes to operate at any given voltage, by adjustment of the resistivity of the base region of the diode. This however can only be done within certain limits of accuracy. Any given batch of diodes will have a certain spread of voltages values. Consequently it is normal to specify the voltage ratings within say a plus or minus 5%, plus or minus 15%, etc. tolerance giving a nominal a maximum and a minimum voltage. The nominal values are similar to the preferred range of resistors, etc., e.g. 3.3v, 3.9v, 4.3v, 4.7v.., etc.

Applications

Of the many varied uses of Zener diodes, some applications may call for the diode to have an accurately specified working voltage with low tolerance; while others may just require a stable source of voltage, for example; reference purposes.

The variety of applications is too numerous to mention all, but we will outline a few more representative applications.

The first of these is a voltage sensitive relay. See Fig. 1. A typical use here is to control a relay system with a fluctuation in voltage rather than a break or reversal of voltage.

The application, which is perhaps one of the most obvious, is the use of the zener diode as a voltage regulator, or reference source (see Fig 2). For Regulator application a low slope resistance and high power handling capacity are desirable features, while for reference purposes, stability of reference voltage with time, and a low temperature co-efficient, are the most important factors. Suitably chosen voltage reference diodes, appear at the moment to be comparable with industrial type voltage standards, in their voltage stability.

Another large field of application lies in the use of the diodes, as limiters and clippers (see Fig. 3). This circuit can be used for the protection of transistor equipment from surges in supply voltage. If a balanced clipping action is desired then 2 zener diodes can be connected back to back (see Fig. 5). Some special double diodes are being produced for this purpose.

Due to the fact that these diodes have a much lower reactance to A.C. than their D.C. resistance, they can be used as a very efficient coupling medium. They are particularly valuable as coupling elements and for decoupling purposes in D.C. amplifiers, and in A.C. coupled amplifiers for low frequency operation, if for no other reason than space (see Fig. 4). Figure 4 shows these diodes being used as a coupling element and for fixed cathode bias in a D.C. amplifier. They are also ideal as a source of fixed cathode bias in audio

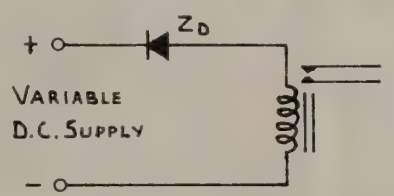


FIG. 1—Application as a Voltage Sensitive Relay.

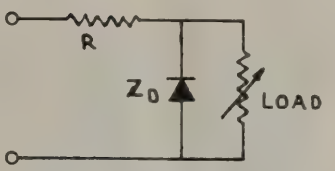


FIG. 2—Application as a Voltage Regulator or Reference Source.

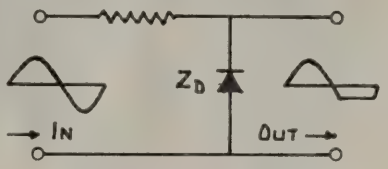


FIG. 3—Surge limiting circuit using a Zener Diode.

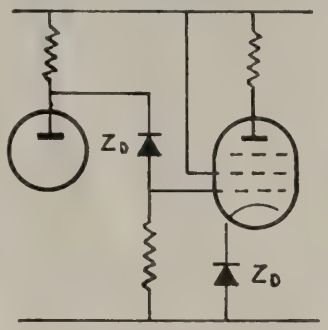


FIG. 4—Zener Diodes used for coupling element and cathode bias in a d.c. Amplifier.

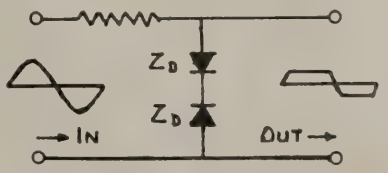


FIG. 5—Balanced Clipping Circuit using back to back Diodes.

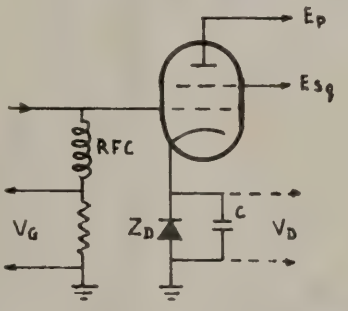


FIG. 6—Protection for Transmitter Power Tubes.
VG = Operating Bias.
VD = Protective Bias.

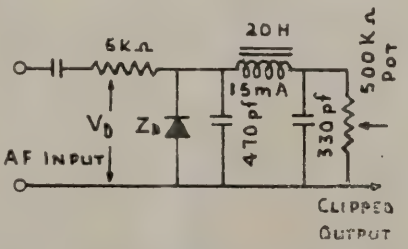
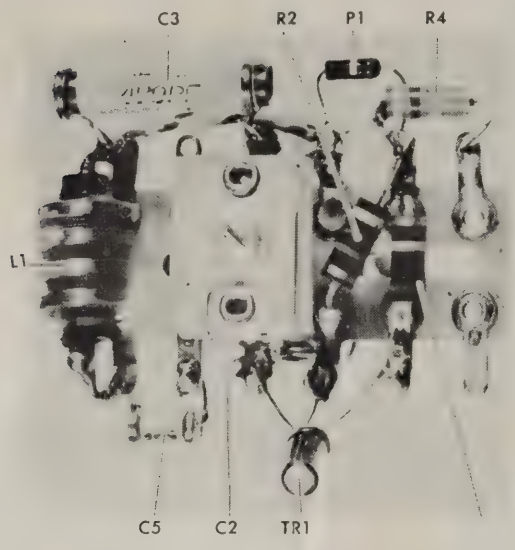
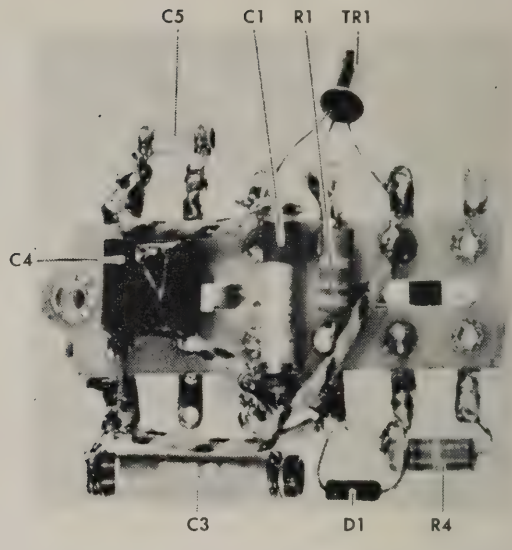


FIG. 7—Speech Clipper for use with A.M. Modulation Systems.





A TRANSISTOR BEAT FREQUENCY OSCILLATOR

By R. J. HALL

In response to a request from one of our readers a B.F.O. has been designed and tested.

- Frequency: 450-460 Kc/s.
- Operating Voltage: 100-300 v.
- Stability: Very good.
- Operating Current nearly equal to 5 ma.
- Cost: Approx. 55/-.

The circuit consists of a Colpitts oscillator using a standard 500 microhenry TV peaking coil tuned by C1, C2 and C3 to nearly equal to 455 Kc/s which is adjustable by varying C2.

In the writer's model C2 is a 5—50 pF trimmer which is preset to give the required B.F.O. note. If desired a 50 pF variable capacitor may be used in place of C2 and can be mounted on the receiver front panel to give the operator control over the pitch.

(Note that a capacitor with both stator and rotor plates insulated from the receiver should be used).

The output of this unit should be enough when mounted "as is" underneath the chassis by actually connecting the unit to the diode plate as shown in the circuit diagram. However, should you build yours into a metal housing then this circuit connection will have to be made. The point marked A can be connected to the HT line of any normal receiver having a H.T. voltage between 100v and 300v, the voltage being dropped to 6v by R4 and kept constant by the Zener diode D1.

PARTS LIST

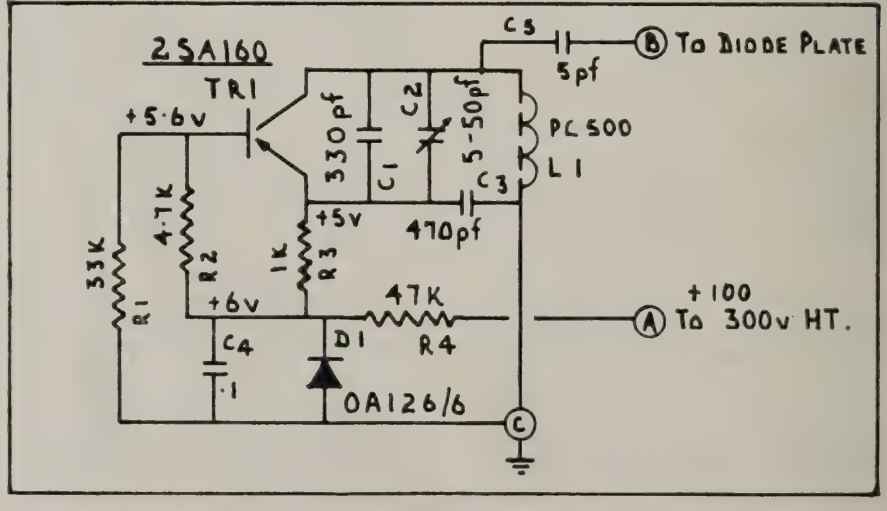
TR1 — 2 SA160 (N.E.C. brand)
D1 — OA 126/6 (Telefunken)
L1 — 500 microhenry peaking choke (Radio Shack Type PC500)
C1 — 330 jF S/C
C2 — 5/50 pF Ducon trimmer
C3 — 470 pF S/C
C4 — .1 mfd. 100 v. Rubycon
C5 — 5 pF S/C (see text)
R1 — 33K ½w 10%.
R2 — 4.7K ½w 10%.
R3 — 1K ½w 10%.
R4 — 47K ½w 10%.

Construction

The constructor may build the B.F.O. in any form at all as it is not critical as to layout. The accompanying photographs may help.

Adustment

After carefully building and checking your B.F.O., connect it to the receiver as indicated and adjust C1 for the desired note.



A COMPANION RECEIVER

(Continued from Page 14)

tion will require the I.F. gain to be advanced to a point where, depending on the signal strength of the station being received, good A.V.C. control is ensured to compensate for fading and other variation in signal whilst in motion. In most cases the audio gain is used about ½ to 2/3 on.

The selectivity, considering only the single IF stage, is reasonable for amateur band use. and also suitable for Broadcast reception. The oscillator section of the mixer appears to be sufficiently stable with respect to vibration and voltage changes, that little retuning is required whilst in the course of QSO.

All these factors of course make for less attention to the receiver during operation therefore ensuring safe driving conditions.

Ignition Interference

It is recommended that the prospective mobile operator take the following preventative measures, if they have not already been carried out.

1. Install suppressor type plugs, or fit suppressors to the top of all plugs.

2. Install a suppressor or resistor in the high voltage lead to the distributor from the ignition coil.

3. Install a generator condenser from generator armature terminal to frame, or if there is no terminal, fix the condenser across the regulator connections. (Caution—Do not connect any Condenser across the wire to the field in the Generator from the Regulator Unit). Such action will only cause very severe burning of the regulator contacts.

4. Fit a similar condenser from the battery side of the ignition coil to chassis. (Check this whilst listening to the ignition in the receiver, as in some cases this can cause an increase in ignition noise pickup.

Interconnecting Receiver and Transmitter

If this is desired the antenna and HT 12v should be fed through the send-receive switch in the transmitter.

It is hoped that this receiver will provide entertainment for the family whilst being usable as an amateur band mobile receiver. For a total 6v. drain of 1½ amps.

LOOKING AT ZENER DIODES

(Continued from Page 21)

power amplifiers, instead of using fixed grid bias for optimum output performance.

A useful tool for the transmitter constructor, the zener diode can be used as a means of protection for Class C, Final amplifier tubes, if the excitation is removed. A power type regulator can be connected in the cathode circuit of the amplifier (see Fig. 6.). The protective bias is obtained from the diode and the extra additional bias to give correct Class C operation, is derived from the grid leak by the grid current. It should be noted, however, that the voltage between anode and ground, is reduced by the amount of protective bias. The actual value of the bias voltage and thus the working voltage of the diode, can be easily calculated from the tube tables.

Another idea for the radiotelephone operator is the use of a zener diode as a speech clipper in the audio system (see Fig. 7). The low energy speech peaks in amplitude modulation add very little to the effectiveness of speech communication; in fact, they only limit the amount of speech power delivered to the carrier because the percentage of modulation depends on these peaks. If the low energy speech peaks are clipped off, the remaining wave form will have a higher average power-to-peak amplitude ratio. This gives more useable sideband power and thus higher Phone Transmitter effectiveness.

In designing the clipper, the clipper diode should be chosen to be ½ to ⅓ the value of the peak AF input voltage and greater than the peak value that will modulate the carrier 100%. The 5K resistor is to limit the current through the preceding amplifier when the peak voltage input rises above the diode breakdown point.

A low-pass filter is necessary to attenuate the high frequency component of the clipped wave and the filter shown, attenuates frequencies above 3,000 cps.

The output is adjustable so 100% modulation can be achieved with the clipped wave. With moderate clipping levels of 6 to 12 db, there is little change in quality and it is possible to use as much as 20 db of clipping before intelligibility suffers.

It is hoped that sufficient information has been given regarding these new and versatile components to stimulate interest in them, and their application, and give some guidance on their use.

References

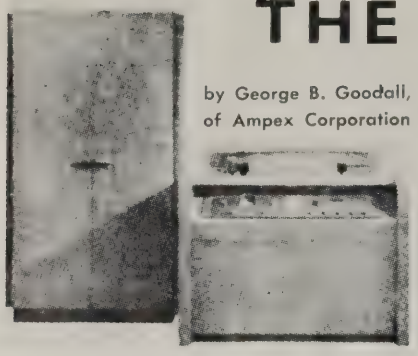
Texas Instruments Application Notes No. 2.

Zener Diodes—their properties and applications: J. M. Waddell and D. R. Coleman.

Wireless World, January 1960.

S.T.C. Components Handbook, Volume 5.

Electronic Designers Handbook, Landee Davis and Albrecht.



THE VIDEOTAPE* RECORDER

by George B. Goodall, of Ampex Corporation

The fifth and final part of an article which appeared originally in "International Projectionist," April to August, 1959.

V. CONTROL SYSTEMS & SPECIAL TECHNIQUES

AS PREVIOUSLY indicated, certain servo control systems were necessary to enable the rotating video head approach to be a practical solution to the problem of recording and reproducing the video signal. Four servo systems are employed in the Videotape Recorder.

Head-Drum Motor Servo Systems

Two servo loops are employed in the head-drum motor circuit. The first acts to eliminate fast phase correction requirements for the motor; the second minimises any tendency of the motor to "hunt."

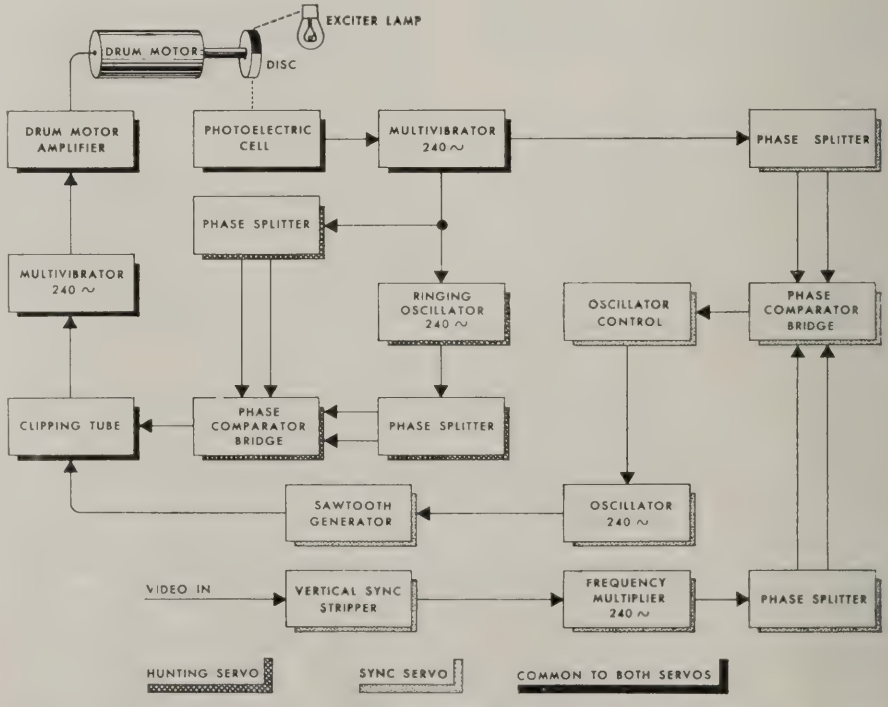
The head-drum motor rotation is controlled by a 60-cycle system reference frequency. In the record mode this frequency may be derived from the vertical synchronising pulses in the video signal, from an external source, or from the power line frequency. Normally it would come from the video signal. This frequency is multiplied to 240 cycles routed through a phase-comparator circuit and motor-power amplifier, and then used to drive the head-drum motor.

The 60-cycle vertical sync is stripped off the video signal, multiplied to 240 cycles, split in phase, and used to provide two of four inputs to a phase-comparing bridge circuit. The other two inputs to the phase comparator are supplied by the photoelectric cell, whose output is split in phase. These last two inputs are directly dependent on the position and speed of the rotating heads.

The phase-comparator generates an error voltage whenever the sync signal suddenly shifts in phase—for example, when an inductive load is applied to the sync line. This d-c error signal controls the frequency of a voltage-controlled oscillator; however, a large error signal will not immediately affect the oscillator, but will gradually shift its frequency. The output of the oscillator is converted to a saw-tooth wave and is connected to the third grid of a clipping tube. Now let's develop the signal to the first grid of that tube.

The second drum-motor servo loop utilises the photoelectric cell output as the excitation signal to a low Q ringing oscillator, resonant at 240 cycles. The resulting signal is again an approximate 240-cycle square wave, whose phase is displaced from the original by 90° plus or minus an amount proportional to the difference between the actual photoelectric cell output and 240 cycles. [This additional phase shift occurs if the signal is not exactly 240 cycles and is the result of feeding a non-resonant signal through a resonant circuit.] The output of the ringing oscillator is split in phase and provides two of the four inputs to another phase-comparator bridge arrangement.

The other two inputs to the phase-comparator bridge are derived from the photoelectric cell output, which is split in phase. The phase-comparator will emit an error voltage whenever the two pairs of input signals are not



Simplified block diagram of the two head-drum motor servo systems. Note that certain components are common to both servos.

in phase: for example, if the head-drum motor velocity changes during a "hunting" period. The instantaneous output voltage is proportional to any instantaneous difference between the actual frequency from the photoelectric cell and 240 cycles. The error voltage is further processed, and then is connected to the first grid of the clipping tube (which we introduced three paragraphs ago).

The clipping tube now has a sawtooth wave on the third grid which will vary gradually as incoming sync varies, and a voltage on the first grid whose amplitude will vary instantaneously with any transient variation in motor speed. The two signals are combined in such a way that the eventual signal has a linear phase-shifting characteristic proportional to both.

This last signal is the one that controls a multivibrator circuit, whose output is amplified in the motor drum amplifier and then used to drive the drum motor. The motor will thus be brought gradually into synchronism with any change in sync phase or frequency, but will be rapidly corrected for transient shifts in motor speed "hunting."

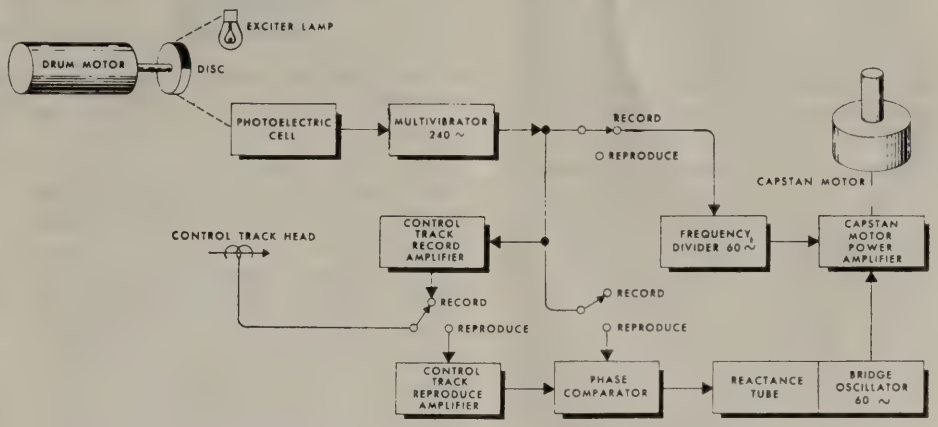
Capstan Motor Servo Control System

During the record mode the 60-cycle system reference frequency is the primary motive force for the drum motor, as we have seen. The cell scans a rotating disc on the motor shaft and generates a 240-cycle signal whose phase and frequency are dependent on the head drum. This signal is progressively divided by two, with a resulting 60-cycle signal supplied to the capstan motor circuit. The rotation of the capstan motor during recording is thus electronically-coupled to the rotation of the head drum. The 240-cycle signal is also recorded on the bottom edge of the tape as a control track.

In the reproduce mode, the recorded 240-cycle control track is reproduced from the tape and compared in phase with the output of the photoelectric cell. Both these signals are converted to square waves and connected to a phase-sensing circuit. As long as they are exactly 90° out of phase there will be no error voltage generated. However, when the phase angle from the control track and the photoelectric cell differs from 90°—which will occur if the capstan rotation is not synchronised with head drum rotation—a resultant positive or negative d-c voltage will be created.

This voltage controls the operation of a reactance tube which is one of the frequency-determining elements of a bridge-oscillator circuit. The bridge-oscillator output is routed through the capstan motor power amplifier to the capstan motor.

Any phase error is thus translated into a control voltage which varies the frequency of oscillation and thus corrects the capstan motor speed.



As shown on this simplified block diagram of the capstan motor servo system, capstan motor rotation is controlled by the drum motor in the "record" mode, and by the comparison of the reproduced control track and the drum motor signal in the "reproduce" mode.

Tape Guide Servo System

We have already seen how the position of the concave tape guide is vitally important in producing interchangeable tapes. The final servo system in the equipment controls this placement.

In manual operation the position of the guide is controlled by the manual adjustment of a potentiometer which forms one branch of a self-balancing bridge. The other branch of this bridge consists of a precision potentiometer which is mechanically-geared to a tape guide motor. A voltage differential across the bridge is created when the manual control is reset.

This voltage is amplified in the Tape Guide Amplifier unit and used to control the tape guide motor, which will operate to rebalance the bridge. In moving to correct the unbalanced bridge position, the motor repositions the guide, which is mechanically coupled to it.

Automatic operation is possible only in the reproduce mode. Under automatic control the tape guide motor is controlled by the Automatic Compensation Sensor Circuit. This unit detects time displacement errors in the horizontal sync pulses which immediately precede and follow a head-switching interval, as compared with the horizontal sync pulses during a normal period.

If a timing error be produced each time the heads are switched, the charging time for a capacitor is either lengthened or shortened, and the capacitor will charge to a greater or lesser potential than normal. This signal is further processed and then used to drive the Tape Guide Amplifier which in turn supplies power to the tape guide motor to reposition the guide and correct the timing error.

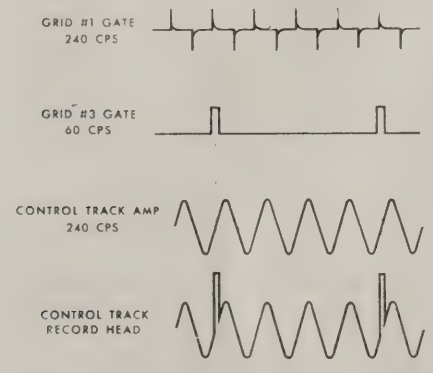
Editing and Splicing

Field-indicating pulses are derived from the photoelectric cell output, which is differentiated into pulses and then passed through a gating tube. The gating tube passes these pulses only

when they occur in coincidence with the vertical sync, thus every fourth pulse from the photoelectric cell is passed. These pulses are then combined with the control track signal and magnetically indicate on the tape the vertical blanking time interval.

If we now make the magnetic recording visible, we can make our splice immediately following this vertical blanking time and there will be no discontinuity in the control track signal. The TV picture will not then be affected (an improperly made splice will cause picture "roll-over").

A recent Ampex product called "Edivue" suspends metallic powder in a solution. When Edivue is applied to a recorded TV tape, using a special wick-type pen, the metal powder adheres to the magnetised tracks (in much the same way that iron filings form a pattern on a sheet of paper laid over a magnet). The solution quickly evaporates, leaving a visual pattern of metal powder

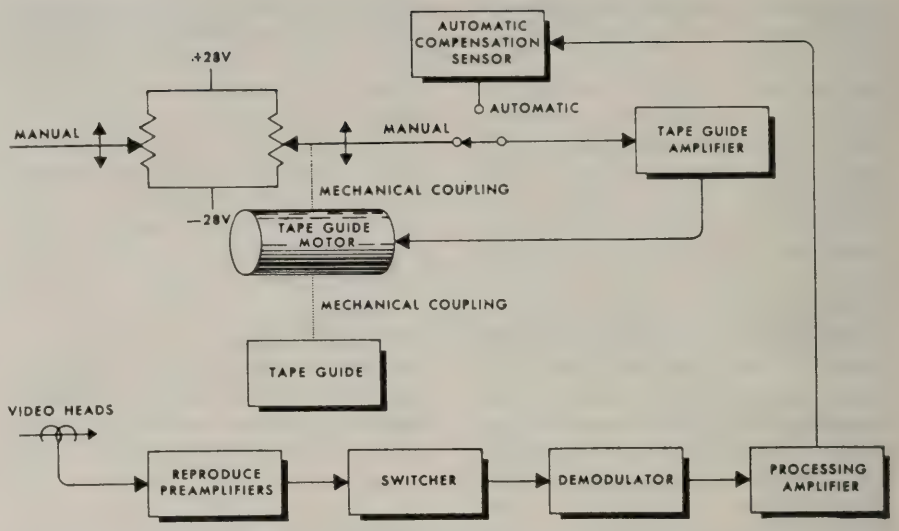


This diagram illustrates how the field indicating pulses are mixed with the control-track signal.

marking the magnetic fields on the tape, with the field pulses appearing as sharp blips on the bottom edge of the tape.

Two methods may be used in locating the exact spot for editing. The first is to manually move the tape past the audio head until the proper spot on the soundtrack is located; the tape is then marked at the video head.

The second method is to watch the TV monitor and stop the equipment the instant the desired scene is reproduced; the tape will move approximately 4 inches after the desired scene is viewed



The tape guide servo system is shown here in simplified block form. The tape guide amplifier controls the tape guide motor. Automatic operation is possible only in the reproduce mode.

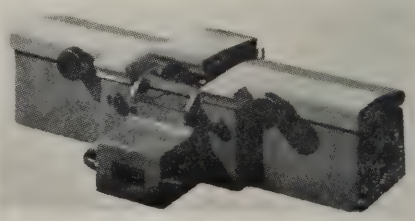
(this takes the reaction time of the operator into account) so the tape is marked 4 inches to the right of the head-drum. The maximum deviation here will be 2 picture frames, and will be invisible to viewers. There are 60 splicing points in every second of picture information and the point nearest where the tape was marked may be used.

The audio record head is $9\frac{1}{4}$ inches, or 0.62 seconds in tape travel, behind the video head. This time lag provides a workable basis for splicing, permitting cuts during a scene change, or even between words. Exact synchronisation is always maintained between sound and picture, since it is inherent in the TV recording process the same as it is in the motion picture recording process.

The removal of one second of sound means the loss of 30 frames of video information, and if the picture was of an object in motion a jerking movement would be noticeable. If, however, the splice is made at the beginning or end of a scene, no effects will be apparent.

Actual cutting and splicing should be done using a precision machine, the Videotape Splicer, now available from Ampex. This equipment allows cutting to an accuracy plus or minus 1 mil. The two tape ends are placed in the splicer. Micrometer knobs are used to position the field pulses on both pieces of tape under hairlines on a lens, then a single-edge razor blade is inserted in a cutter guide and drawn across the width of the tape. As both tape ends are cut simultaneously, a perfect butt splice is assured.

Without removing the tape from the splicer, the cut ends are lifted and special splicing tape is run underneath. The tape ends are then lowered on the splicing tape, and a pressure arm seats the splice. The splicing tape is trimmed (again using the cutter guide) and the tape is removed from the splicer. The metallic de-



Precise editing and splicing is accomplished by the Videotape splicer.

posit is carefully wiped off, to prevent contamination of the head assemblies, and the spliced tape is ready to be played.

Duplicating Recorded Tapes

Copies of Videotape recording are used on the air every day. A very slight deterioration in the signal-to-noise ratio occurs, but the copies are fully acceptable, in

THE VIDEOTAPE RECORDER

fact, even copies of copies have been broadcast.

The only present method of making duplicate tapes is to use one Viedotape equipment as a reproducer which is connected to one, or more, Videotape machines used as recorders. The number of copies which can be made in this way is limited only by the replay life of the originally-recorded tape.

It is interesting to note that Videotape programmes are now available for general distribution throughout America. This attests to the acceptability of duplicated tape, and to the fact that complete interchangeability of tapes from machine to machine has been achieved.

Conclusion

We hope that these discussions have proved of some interest to you. It should be understood that this process is constantly being refined and improved—in fact, Ampex has a group of engineers searching out new applications and improved circuitry for the Videotape Recorder. But a fundamental knowledge of the design presently used will aid in understanding any new processes, which must of necessity stem from the basic equipment. We hope this series has aided you in attaining that fundamental knowledge.

Unusual T.V. Reception Possible

The indications in the northern hemisphere, over the past few months of intense and long lasting periods of sporadic ionisation in the E layer of the ionosphere, could well be repeated in the coming summer in New Zealand and Australia. Although it is impossible to predict such occurrences, there is a history of marked increases in the appearances of sporadic E ionisation, in the periods of lower sunspot activity.

Such prospects then, are intriguing, for periods of long range communication on frequencies not normally propagated by the ionosphere. Christchurch and Auckland T.V. set owners should watch each other's Channel with care, for unusual propagation could produce results anytime during the coming months, until January 1962. Those Christchurch viewers who find peculiar effects on their screens during the next few months may be viewing Australia Channel 2. Although not operating on exactly the same Channel; (Australia Channel 2, 63-70 megacycles—N.Z. Channel 3, 61-68 megacycles); manipulation of the fine tuning control may enable the Australian Transmissions to be viewed, although severe fading and multi-station reception may be evident. Our editorial staff is interested in receiving any reports of Channel 2 and 3 reciprocal viewing, and any evidence of the reception of Australian Channel 2. We would also be very interested to receive reports of Australian Channel 7 or 9 which although unlikely, are not impossible under the forthcoming ionospheric conditions.

* * *

STEPPING STONES TO TELEVISION

(Continued from Page 11)

mental station in the 1YA building at Shortland Street, Auckland. In 1960 this station was expanded and N.Z.B.S. Channel 2, Auckland, began regular nightly telecasts of entertainment programmes. A further step forward was taken in 1961 when commercial transmissions commenced.

The next phase in the introduction of television in New Zealand was the calling of tenders for equipment for Wellington, Christchurch and Dunedin. The contract was awarded to Amalgamated Wireless for the supply of Marconi transmitters and Marconi 4½in. Image Orthicon Studio Cameras and R.C.A. telecine channels and television links. The Christchurch television service was inaugurated on the 1st June 1961 from N.Z.B.S. Channel 3. A month later N.Z.B.S. Channel 1, Wellington, was opened. The introduction of a television service in Dunedin unfortunately was delayed, but a station is planned for installation in that city.

The equipment which comprises a television station is very extensive, as the illustrations show, and extremely complex. The N.Z.B.S. has been acknowledged overseas for the high technical standards maintained in broadcasting and it is therefore fitting that New Zealand engineers rose to the new challenge and have achieved a major result in establishing a television service, the quality of which is unexcelled overseas.

* * *

TELEVISION SYSTEM FOR NEW LINERS

Passengers in the new 45,000-ton P. and O.-Orient liner Canberra are able to enjoy local television programmes at ports of call throughout the world, and closed circuit telecine and live programmes while the ship is at sea.

"Canberra's" television installation follows the pattern successfully inaugurated in the new P. & O.-Orient liner "Oriana,' which had the first seagoing system of its kind in the world. The installations for both vessels were designed and installed by this Company, to orders negotiated by The Marconi International Marine Communication Company.

The installations provide for the reception of television broadcasts employing the 405-line system used in Britain, the 625-line system used in Australia and the greater part of Europe, and the 525-line system used in many other countries, including the U.S.A. and Canada.

Wherever alternative programmes are available, viewers are able to change from one channel to another by using the normal channel selector switch on the receiver. A major feature is the use of standard proprietary receivers, the incoming broadcast programmes being processed as appropriate in a central television control room adjacent to the radio office before distribution to the receivers. Initially, some fifty television receivers are being used in public rooms and first class cabins, but provision has been made for increasing the number to a maximum of around 350 at a later date, without any alteration to the basic installation.

The processing equipment in each vessel includes two Marconi Vidicon Camera channels which also form part of "Canberra's" closed circuit installation. Each of the two camera channels is associated with a separate 16 mm. film projector and a separate slide projector.

On the high seas, out of range of television transmitters, passengers are entertained by closed circuit programmes mainly derived from a library of 16mm. films; but the camera can also be used to screen studio scenes, interviews and outside shots with no additional equipment.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars, contact Advertising Manager, "R. & E.," Box 1365, Auckland.

ROOMCALL SYSTEM FOR HOTELS

A three-in-one "roomcall" system for hotels that replaces internal telephone system, radio programme distribution and room-service bells has been announced by a U.K. firm.

It provides two-way speech communication between a reception desk master unit, service room master unit, etc., and individual guestroom units. The guestroom loudspeaker units, which have individual volume control, also serve as the medium for the dissemination of two radio programmes, either of which can be selected by push-button.

Master units for hotels and motels of 10, 20 or 30 rooms are available as standard units, but larger installations can be provided. For hotels where the reception desk closes early, a changeover switch can be wired to channel calls to a night-duty master unit elsewhere; or, for small hotels that do not want several master units, a portable plug-in master, which can be used in a number of pre-wired positions is available.

Calling a room involves depressing the room number and "Ring" buttons on the master unit to sound a buzzer in the guestroom. The guest replies by pressing the "Reception" button on the room unit, and the room number button on the master unit is illuminated. Conversation can then take place; for privacy, the master unit is equipped with a conventional telephone handset instead of a loudspeaker. When a guest initiates a call, the room number button on the master is illuminated and a buzzer sounds.

An extra facility designed to appeal to motel operators is the provision of a lamp in the guestroom unit which can be switched on from the master unit to tell a guest returning to his room that reception has a message for him. Where master units have been installed in more than one position, lamps on the guestroom unit indicate which master is calling.

Master and guest units are housed in oak cabinets which can be supplied to harmonise with the interior decoration of a particular hotel or motel. Dimensions of a 10, 20 or 30-line master are: width 14 ins., height 10 ins., depth 9 ins. Dimensions of a guestroom unit are: width 9 ins., height 7 ins., depth 5 ins.

[Private Telephone Department, AEI Telecommunications Division, 3 Avon Trading Estate, Avonmore Road, London, W.14.]

* * *

RCA BRINGS UNIVERSAL TRANSISTOR CLOSER TO REALITY

o The Radio Corporation of America has announced the development of a new silicon transistor that can perform the jobs of up to 40 per cent of the more than 2,000 transistor types now on the market.

RCA described the development as a "significant step" in the search for a universal transistor—one that can handle every combination of power, frequency and energy required to operate modern electronic equipment.

The new unit is the first in the industry adaptable to a wide variety of uses in the complex electronic circuits of military weapons and communications systems, industrial control devices, data processing equipment, and high quality consumer products, according to T. R. Hays, Marketing Manager, RCA Semiconductor and Materials Division.

The first public showing of the device was made at the end of August at the 1961 Western Electronics Show and Convention in San Francisco.

Mr. Hays said the search for a universal transistor was prompted by the "astonishing growth in the number and kinds of transistors made.

"This has created inevitable headaches for equipment manufactures in terms of purchasing, maintaining adequate and sufficiently diversified inventories, and in selecting transistors best suited to a given equipment design," Mr Hays stated.

Therefore, he declared, "RCA's development of an all-round, workhorse device capable of high performance over an extended sweep of applications and circuit requirements is of first rate importance."

The new 2N2102 transistor owes its virtuoso performance to a newly perfected manufacturing technology, Mr. Hays disclosed. "We have succeeded in wedding triple diffusion and planar manufacturing techniques, both relatively new and highly exacting processes, in a single transistor. Along with other techniques, they have combined to give the 2N2102 phenomenal powers for amplifying, switching or regulating current flow—the three primary areas where transistors are used. In addition, they afford the device great electrical stability and reliability," Mr. Hays said.

Comparing the unit's versatility to that of a singer with a range of five octaves (two are considered excellent), he explained that some fifty-five electrical and mechanical tests must be conducted on the new transistor during production to insure high performance across the great breath of applications in which it can serve. This is many more tests than required on standard products, he observed.

Scheduled for commercial introduction into the military and industrial markets early next month, the 2N2102 is expected initially to sell in the 12.00 dollar range in production quantities, Mr. Hays indicated.

Additional Technical Information

Collector to base voltage
120 volts maximum
Collector to emitter voltage (with base open)
65 volts maximum
Collector current
1 ampere maximum
Dissipation at case temp. of 25° C
5 watts maximum
Storage temperature range
—65 to 300° C
Operating temperature range
—65 to 200° C
Gain-Bandwidth product
60 mc
Switching speed (non - saturating mode)
30 nanoseconds maximum
60 volt collector reverse leakage
2 nanoamperes maximum
Beta limits:
At 0.00001 ampere
10 minimum
At 0.0001 ampere
20 minimum
At 0.01 ampere
35 minimum
At 0.15 ampere
40 minimum, 120 maximum
At 0.5 ampere
20 minimum
At 1.0 ampere
10 minimum

Enquiries: A.W.A. (N.Z.) Ltd., 126 Wakefield Street, Wellington, C.1. P.O. Box 830.

Export and The Solartron Electronic Group Ltd.

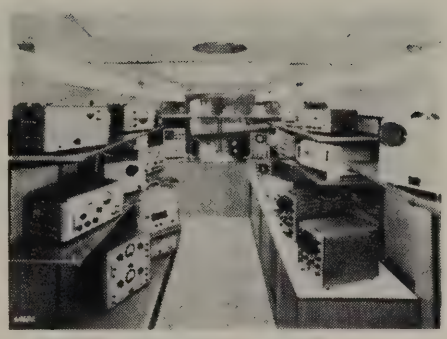
In furtherance of The Solartron Electronic Group's intensive drive on world markets they have just commissioned a specially built mobile demonstration showroom for use in Europe.

The vehicle, which is the largest non-articulated showroom of its kind in the U.K. is fully equipped to demonstrate electronic equipment and includes its own power generator; also provides living quarters for its crew of three, and includes kitchen with refrigerator, clothes drier and cooking facilities.

This mobile demonstrator left Tilbury Docks on Monday, June 5th, en route to Poland to supplement the Solatron exhibit at the Poznan Fair. The vehicle left the Poznan Fair on June 22nd when it travelled to the I.M.I.S. Exhibition at Budapest, Hungary, where it remained until July 4th.

The Solartron mobile showroom carries a very comprehensive range of Solartron equipment, such as a Digital Data Recorder, a 100 channel Digital Data Recorder System with alarm facilities and typewriter output, a complete range of precision electronic instruments, a range of Solatron Oscilloscopes, including the now famous CD.1014 Portable Double Beam Oscilloscope, the new Pulse Generator GO.1005, Dynamic Analysis and Servo test equipment, the LP.942 Fast Analogue to Digital Converter and associated translator unit, Digital Voltmeters, the NT.4-980 Vibrating Cylinder type Transducer, and General Purpose Analogue Computers SC.30 and SC.10; the former, together with its peripheral equipment is in operational order. The value of the equipment carried is of the order of £30,000.

Mr. Howard Lord, Sales Manager, Eastern Europe, who has pioneered Solartron activities in Eastern Europe during the past 5 years is in charge of the operation. Mr. Lord joined Solartron as a Technical Sales Engineer in 1953.



After the vehicle returned to the U.K. for re-stocking, it then set out on a further European tour which included visits to the Solartron Companies in France, Holland, Germany, Sweden and Italy.

The chassis of the vehicle was supplied by A.E.C., the body was built by Racall of Slough.

Solartron Electronic Group Ltd., is represented in New Zealand by E. C. Gough Ltd., P.O. Box 873, Christchurch.

* * *

New Broadcast Microphone

The Radio Corporation of America has introduced a new microphone, with built-in amplifier and earphone jack, for use by "man-in-the-street" radio-TV interviewers and for other remote broadcast pickups.

In use, the compact unit attaches by cable to a telephone line for feeding the programme to the studio. A miniature earphone plug enables the

announcer both to hear telephoned cues from the studio and to monitor the microphone's output.

E. C. Tracy, Manager, RCA Broadcast Equipment Department, said the new microphone carries the transistorised amplifier and battery power supply within its thin, cylindrical shape, and provides full-range frequency response with very low distortion.

The microphone weighs less than one pound and can be stowed in a small carrying case for transport.

Enquiries: A.W.A. (A'sia) Ltd., P.O. Box 830, Wellington.

* * *

Transistors Being Tested For Use In Cars

Automobiles may eventually become a major user of transistors, the tiny devices that are replacing vacuum tubes in many applications.

An indication of this is the fact that the Delco-Remy Division of General Motors Corporation in the United States is testing a partly transistorised ignition system that eliminates the condenser and contact points in an otherwise conventional ignition system.

By eliminating points which wear out relatively quickly, Delco-Remy believes that its transistorised ignition system should sharply reduce the time required for maintenance, and hence the time that a commercial vehicle such as a truck would be out of running order.

One of the pilot models made by Delco-Remy has already been tested for 5,000 hours without maintenance trouble.

* * *

Radar Sees Over the Horizon

Radar stations in New York and London may some day watch each commercial airliner every minute as it flies across the Atlantic Ocean or follows some other long-distance flight path.

Should trouble develop and the plane crash, rescue craft could be dispatched promptly and could be told almost exactly where to find the plane, even if the pilot was unable to radio his position.

This is one possible future application of an experimental radar now being tested at the Naval Research Laboratory in Washington.

(Continued overleaf)

The new radar was conceived by Dr. Robert M. Page, director of the laboratory. Unlike conventional radars, it is able to see beyond the horizon by bouncing its electric beam off the ionosphere, the region of the atmosphere that extends from about 50 to about 150 miles (80 to about 240 kilometres) above the earth.

* * *

TRADE AT LONDON'S RADIO SHOW

The ten-day Radio Show in London closed on September 2nd with an attendance averaging nearly 40,000 a day.

Mr. A. L. Sutherland, chairman of the British Radio Equipment Manu-

"We were not so sure about the trade position, but as it turns out business has been very satisfactory.

"It started slowly in the first week, worked up in the second and now several exhibitors have said that it has been their best show for five years.

"Obviously the public's first interest is still in television. This is reflected by the considerably higher sales which were made in July and have been continuing at the show.

* * *

PREMIER AMERICAN AWARD FOR MARCONI

Marconi's and the English Electric Valve Company Limited, associated Companies within the English Electric Group, have been accorded the honour of jointly sharing this year's engineering award of the National Academy of Television Arts and Sciences with the Radio Corporation of America. The award, which is in recognition of the independent development of the 4½ inch image orthicon camera and pick-up tube, is one of the premier honours which America can bestow in the field of electronics.

The 4½ inch image orthicon tube first appeared in the Marconi Mark III camera, which had a tremendous sale before being superseded by the Mark IV camera channel. The latter, embodying further improvements, notably an increased stability and operation and in reduced size and weight, is selling in quantity all over the world, including the United States, where the high quality of its picture has been enthusiastically acclaimed. In Britain, the British Broadcasting Corporation has adopted the 4½ inch image orthicon as its standard, as have several of the independent television programme contractors in this country.

"The public demand for transistor portable radios is insatiable, many manufacturers have already sold their total production up to the end of the year, and tape recorders, gramophone components and other sound-reproducing equipments have also been selling well."

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A GIFT SUBSCRIPTION IS A REGULAR REMINDER.

Shortwave Survey

By MIKE BUTLER

A Listeners' Guide to Broadcasts in English

Greenwich Mean Time is used —Frequencies in Kilocycles.

* * *

A Broadcast from the **BBC LONDON** which is of special interest to us is their "Shortwave Listeners' Corner." This season is now timed between 0825 and 0840 on Sundays in the Pacific Service and provides a valuable commentary on the backroom operations of their organisation. Tests involving listener participation are run and topics which particularly concern us are discussed. The frequencies used are 9510, 11955 and 15375.

* * *

Another session for the Shortwave listener and which is a "must" for the DX enthusiast is Graham Hutchen's broadcast from **Radio Australia.** This is well received here at 2200 each Sunday on 15240. Last week he told us that Radio Australia will not in future employ call signs but will retain their verification card system with the station specified by the frequency used. He also said that at present the overseas service operated four transmitters with the power of 100 kilowatts, two of 50 kw and one of 10 kw, each capable of operating on any of the bands from 11-49 metres. Further expansion is contemplated.

* * *

Radio N.Z. airs our own DX session conducted by Arthur Cushen. It may be tuned on the first Wednesday of each month at 0640 on 6080. Currently The Voice of America's strong signal on the alternative frequency of 11780 prohibits reception on this channel here in Auckland at this time. The programme is repeated at 1030 on the same frequencies.

Still more news for the Shortwave listener originates from **Radio Nederland** on Tuesday evenings between 0725 and 0740 on 11730 and 9590, and from **Switzerland between** 0745 and 0755 on Fridays using 11865 (best) 15315 and 21605.

* * *

Amateur Radio operators may find much to interest them in the "Radio Amateurs Notebook" a weekly broadcast from the **Voice of America.** This has been well received on 17770 and 21740 between 2115 and 2130 on Saturday mornings and repeated on 5955, 6025, 7205, 9615, 11780, 11800 and 15210 at 0730 on Sunday evenings. It is conducted by Bill Leonard, W2SKE.

* * *

A weekly broadcast from **HOLLAND** with universal appeal is the "Happy Station" programme which more than justifies its title. It is heard clearly here on Sundays from 0600 to 0725 on 9715 and through VOA interference on 11780.

SURVEY BY COUNTRY

CANADA. An internal S.W. transmissions from this country has been received here between 0400 and 0430 on 11720. The strength was fairly weak. This broadcast is directed to Central and Western Canada.

CUBA. Radio Havana on 11765 enables clear reception of this country in the afternoon from 0315 to 0415 and 0500 to 0530.

EGYPT. 17690 is sometimes occupied between 1930 and 2000 by Cairo although reception here is by no means regular. This transmission forms part of the new "Voice of Africa" service mentioned previously.

JAPAN. Outlets of Radio Japan are well received locally.
At 1800 on 9525
At 1830 on 11795
At 2000 on 11705
0030 – 0115 on 17725, 21520
0200 – 0230 on 17795
0430 – 0500 on 17725, 21520
0500 – 0510 on 17755
0530 – 0615 on 15235, 17725
0730 – 0800 on 15135, 17725, 21640
0800 – 0830 on 11780, 11815, 17725
0845 – 0915 on 17755
0900 – 0920 on 11815
0930 –1030 on 11785, 15235

The Far East Network of the U.S.A.'s Armed Forces Radio and Television Service (AFRTS) is located at Tokyo and the best reception of broadcasts has been received on 11750 at 0730 – 0900, 0945 – 1015 and 1045 – 1115 and on 15257: 0500 – 0545, 0745 – 0830 and 0900. The strength on the latter frequency is generally poor while both suffer from interference at times, on 11750 notably from the BBC Singapore.

KOREA. Two transmissions from the Korean Broadcasting System in the Republic of Korea have been heard. At 0530 on 15125 and 17810 which was monitored until 0600 at good strength. After this time Korean was spoken.

LUXEMBOURG. The Commercial Station Radio Luxembourg has provided consistent if not very strong signals on 6090. Typically the programme consists of current British Hit Parade recordings. Reception is best between 1900 and 1945.

MONACO. The regular transmissions of the religious station Transworld Radio have been heard well during the periods 1900 – 1945, 0630 – 0700 on 7185 although recently the BBC have rather upset the latter broadcast. There have been many other frequencies quoted by other writers such as 6115, 7110, 7155 and 9705 but they appear to have been experimental only. 7185 has been heard consistently by your correspondent since 8th June last. Recently Transworld Radio has been heard at 0500 until 0515 testing with a massive signal on 11810. They asked for reports many times during the broadcast.

NEW ZEALAND. Radio N.Z.'s present schedule is:
1700 – 1845 to Pacific Is.; 11780, 15280
1900 – 0545 to Pacific Is. and Australia; 15280
0600 – 0845 to Pacific Is.: 6080, 11780

Overseas Notebook . . .

Trade Winds in U.K.

A recent issue of Wireless and Electrical Trader carries some interesting reports on current trends in radio and TV at the 1961 Radio Show at Earl's Court, London. According to the "Trader" there is uncertainty in the public mind over colour television and the line system. There is an enormous public interest in the former although no colour was seen on any sets on manufacturers' stands. This was because it was felt that all models shown to the public should not be prototypes but sets that are actually in production, or about to be. With one eye on the Pilkington Committee report manufacturers are making the best of an indeterminate situation by being prepared for all eventualities. Most of the new television receivers are convertible from 405 to 625 line operation and some have a switch fitted for a simple changeover should transmissions commence on a new system. Transistor sets have dominated sales at the expense of TV sales it is also reported.

Other new trends are an almost complete swing to 19in. and 23in. TV tubes, remote control TV, a more adventurous spirit in cabinet styling, a long low look in radiograms and a continued move to 4 track models in the tape recorder field.

* * *

Printed Circuits

A staff writer in "Radio Constructor" puts a strong case for the general acceptance of printed circuit boards. "Apart from the cost factor, printed circuits can offer a valuable contribution in two alternative ways, these being saving of weight and saving of space. The reason for the saving of weight is fairly obvious, and it arises from the fact that the weight of a unit in excess of its components is the weight of the printed circuit board itself. It is ironic to think that printed circuits can also cause a saving in space because the inherent design limitation of a conventional printed circuit is that all component connections must be made in one plane only. Nevertheless, a saving in space is possible, if only because bulky tag strips and anchoring lugs can be eliminated." The advantages of printed circuit manufacture were first proposed by one John Sadgrove in 1947, but for some reason interest lapsed for some years. From 1955 to 1958 complete printed circuit chassis appeared and manufacturers began to dream of a fully automated production line. However there were plenty of early snags especially in the automatic soldering which showed up at a disadvantage compared with hand soldering. Servicemen, too, were vocal in their objections, and one U.S. Manufacturer, Zenith Radio Corporation saw fit to publish advertisements stating, "No Printed Circuitry in Zenith TV Chassis." This latter was directed mainly to servicemen whose chief complaint was against some of the more complex boards in television receivers. According to the writer, over the last few years further development seems to have made complete printed circuit chassis much more acceptable to the servicemen.

* * *

VLF Station for U.S. Navy

During recent years much emphasis has been given to developments in the high frequency end of the radio spectrum. It possibly comes as a surprise therefore to learn that the Very Low Frequencies are still a part of that spectrum and very much alive.

"International Electronics" reports construction of a VLF station for the U.S. Navy in Machias Bay, Maine, U.S.A. The station is being erected as a component of the Polaris FBM system and the contract calls for installation of an antenna system that includes 26 interconnected supporting towers.

The cables between the towers consist of antenna sections insulated from the towers by chains of insulator links. The porcelain insulators are fitted with giant grading rings which form a safe gradient for 400,000 volts so that the station's power is not dissipated in corona losses or arcing.

The station power house will be able to generate 12 megawatts so deicing operations can be carried out simultaneously with the powerful very-low-frequency transmission. Upon completion the station will be able to send signals throughout the world as well as to U.S. submarines under the sea.

* * *

An Airline Seat Reservation System

British European Airways have signed a £2.5 million contract with Standard Telephones & Cables Ltd. for a computer controlled seat reservation system.

The contract is for the first part of an electronic, automatic seat-booking system which—at an estimated ultimate cost of £4.5 million—will be the biggest of its kind in Europe and one of the most modern and most fully-automated systems employed by any airline in the world.

The first part of the system will be in operation late in 1963 and by the end of 1964, when the system is in full operation, it will be dealing with some 3,000 telephone callers, 280 counter-callers and 500 telegraph messages per hour. This will mean, during the peak booking months, the complete elimination of over half a million reservation record cards, 100,000 flight control sheets and well over a million booking entries which would otherwise have been made by hand.

Four electronic computers will form the heart of the system and will be installed in BEA's new permanent West London Air Terminal, now under construction. Reliability will be ensured by the interconnection of all four computing machines enabling all booking status records to be fully duplicated.

The computer system will handle bookings on all BEA flights up to nine months ahead and store all reservations records for these flights using magnetic drums and rapid-access magnetic tape files. A reservations clerk, using a push-button desk set and a special teleprinter, will be able to enquire about the availability of seats on any flight, select one particular flight from several alternatives offered and make the required bookings. Having booked the required number of seats, the full passenger details are entered through the teleprinter to be stored by the central computer on the magnetic tape file.

Initially only reservations clerks in the London area will be connected directly to the computing centre. Bookings made through other BEA offices and by other airlines will still be telegraphed to the London centre but these messages will in future be automatically processed by the computers.

* * *

British TV Line Standards

A recent editorial in Electronic Engineering reports a wide divergence of opinion on the respective merits of the 405 and 625 line system, a controversy which fortunately for those concerned with television in New Zealand is not likely to engender much heat. The decision which faces the Pilkington Committee whose job it is to sift all the evidence for and against is hardly likely to please all the protagonists in the case. The matter is complicated by the introduction of colour which of course hinges on the decision as to what the future line standard is to be.

The journal wittily sums up: "It may be somewhat out of place, and for a technical journal even heretical, but nevertheless one is tempted to ask, does it really matter or not whether our cowboys are better defined or our indians really red?"

SHORTWAVE SURVEY

(Continued from page 31)

0858 – 1145 to Australia; 6080, 11780.

Sunday only: 0815 – 0845 to Antarctica, 6020.

Call Signs: 6080 – ZL7; 11780 – ZL3; 15280 – ZL4; 6020 – ZL20.

The interval or tuning signal of our overseas service is like the Italian one, a bird sound, in this case the New Zealand Bell-bird spaced 5 seconds.

It is, of course, redundant for us to comment on reception at this distance, but local (Auckland) listeners will find the evening transmissions on 6080 and 6020 very good at present.

PAKISTAN. Excellent morning listening has been obtained on 7010 from 1900 to 1930 and 2000 to 2030. During the latter period the programme was also well received on 11672. At 0630 a session of news was clearly heard on 21590 while at 0930 a further frequency, 17750 was used.

PHILIPPINES. The Far East Broadcasting Co. with studios in Manila is described in the World Radio Handbook as a "non-profit" non-commercial organisation being sustained by free-will gifts and offerings from interested friends." In practice the programmes are largely of a devotional nature which makes their identification easy but for one aspect—the station call and frequency announcements have frequently been made in a deep male voice at a sub-programme level. From 2200 to 2315 fair reception is obtained on 21515. Also 2330 – 0100 on 15385 good, except at the end of this session when it suffers from interference; 0830 – 0915 fair on 15300; at 1000, a news session at good strength on 6030. The outlet 17805 is heard here at these times: 2030 (English announcement only); 2330 – 0000; 0230 – 0300; at 0400; 0545 (announcement only); 0730 – 0800; 0830 – 0930. The strength is generally weak on this frequency but these transmissions are regularly received.

POLAND may be tuned through interference on 9675 between 2030 and 2100. At the end of this period they proceed in a foreign language.

PORTUGAL. Lisbon is noted at fair strength on 6025 and 15380 in the mornings with an informative broadcast describing this country as well as news and talks on current affairs from 1830 to 1915 when the signals fade.

* * *

In these notes we adopt an "order of time" approach to the setting out of multiple broadcasts from one country or organisation. This aids easy selection of frequency at the time you find most convenient to listen. We begin at 1800 GMT (6 a.m. N.Z. Time) through 0000 GMT (Noon N.Z. Time) and then through the New Zealand afternoon and evening in which the GMT numerals can be directly translated to New Zealand time, i.e. 0430 GMT = 4.30 p.m. New Zealand Time.

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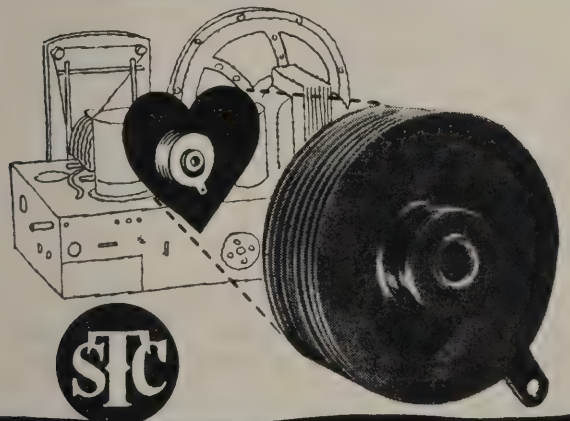

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CHRISTCHURCH: November 14-15: Supper Room, M.U.I.O.O.F. Hall, 168 St. Asaph Street, Christchurch.

DUNEDIN: November 16-17: Physics Department, University of Otago.

Although not entirely necessary, phone or write giving number of personnel desirous of attending and we will suggest a time when we would like to have you with us.

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AG 9 U	Audio Generator	£26/7/8
AG10	Audio Generator	£34/12/3
★ AR 3	Communication Receiver	£18/15/3
C 3U	Condenser Checker	£12/2/3
DF 2	Direction Finder	£46/18/0
DF 3	Direction Finder	£67/0/0
★ DX 4OU	Transmitter	£45/12/0
★ DX 6O	Transmitter	£56/0/0
FD 1-12	Fuel Vapour Det'r	£24/2/0
★ GC 1 A	Communication Receiver	£68/18/0
★ HW 19	Ten Meter Transceiver	£26/16/5
O 12	5" Broad Band Scope	£45/6/6
OM 3	5" Service Scope	£28/4/0
QF 1	"Q" Multiplier	£7/6/10
RF 1	Signal Generator	£20/3/3
T 4	Signal Tracer	£13/16/0
TS 4	TV Sweep Generator	£34/4/0
V 7AU	V.T.V.M.	£17/1/9

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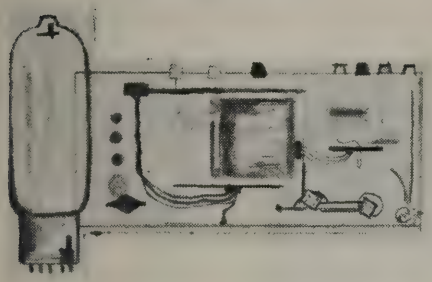

service shop

This month I'll start off with a little "hate session" directed against the "Do It Yourself" types.

The first item concerns a radiogram chassis brought in by a youth and his father. The latter's story was that the son knew quite a lot about radio, etc., and when the chassis had stopped functioning sonny had decided to fix it himself. Well, "fix it" he did.

Turning the chassis upside down on the counter the youth said that "this resistor" (the main H.T. dropping resistor) had got red hot and had fallen to pieces; whereupon he deduced that the filter condenser had shorted to the chassis. He had therefore replaced it. He then produced the old one which was checked and found to be O.K. The son had also replaced the resistor with two 330K 1 watt units in parallel (the original was a 1K 5w wirewound unit), but he found that the set was still dead. With a manner which suggested that all servicemen crawled out from under stones he handed the set over to me.

The first thing I did after putting the chassis on the bench was to insert the correct resistor and tidy up the horrible mess which sonny had made (I think he must have held the soldering iron with his feet). Then, after tracing the original fault to a short between screen and cathode of the 6BU7 output tube and replacing the tube all went well. Needless to say a "small" surcharge was added to the account for the trouble taken to clean up someone else's mess.

The other job concerns a small AC/DC portable. The owner in this case having got himself a multimeter had decided to "overhaul" his portable. The first thing he did was to measure the plate and screen voltages which on this model are about 60-70 volts. Then moving his probes to the filament line he measured it as 9 volts which is about right. However, on seeing that the filter condenser connected to the filament line was a 25 volt unit he reasoned that the set would go better if the voltage was 25 volts instead of 9 volts. So with this in mind he lowered the value of the series dropping resistor and then, he said, "a peculiar thing happened." The filaments on the tubes, much to his astonishment, all glowed very brightly for a moment and then the set stopped. Try as he might he could not get it operating again and decided to bring the set into me for repair.

Well, after replacing the dropping resistor with one of correct value (1.5K in this case), I checked the tubes for open filaments and found both 1T4's had open filaments. After replacing these tubes the set performed as well as this model usually does.

As I write I have just finished repairs to a large English receiver brought to New Zealand by a South African. The complaint was that since arriving in New Zealand the set was weak although just prior to packing it had been O.K. To cut a long story short I switched on the set and sure enough it sounded clear but weak. The trouble seemed to be in the audio end as it received all the stations quite well but lacked punch. Removing the chassis I checked all the voltages, etc., on the output and first audio tubes and found them to be O.K.

As I was putting the EL33 back I noticed the loudspeaker for the first time. It seemed a little odd!! . . . The cone was almost inverted. Closer inspection revealed that the cone had in fact been pushed so far out the voice coil was clear of the magnet. A new speaker and the set was as new.

On questioning the owner when he came to pick up his receiver, the real story came out. His "good lady" had carefully removed all the valves and wrapped them up and while doing this had noticed that the cone of the loudspeaker was free to move back and forth. She had therefore stuffed large quantities of newspaper between the cone and speaker housing, ramming them home with a ruler.

I wonder what was said to the "good lady" when my customer reached home that night and told her "how much."

—R. J. Hall

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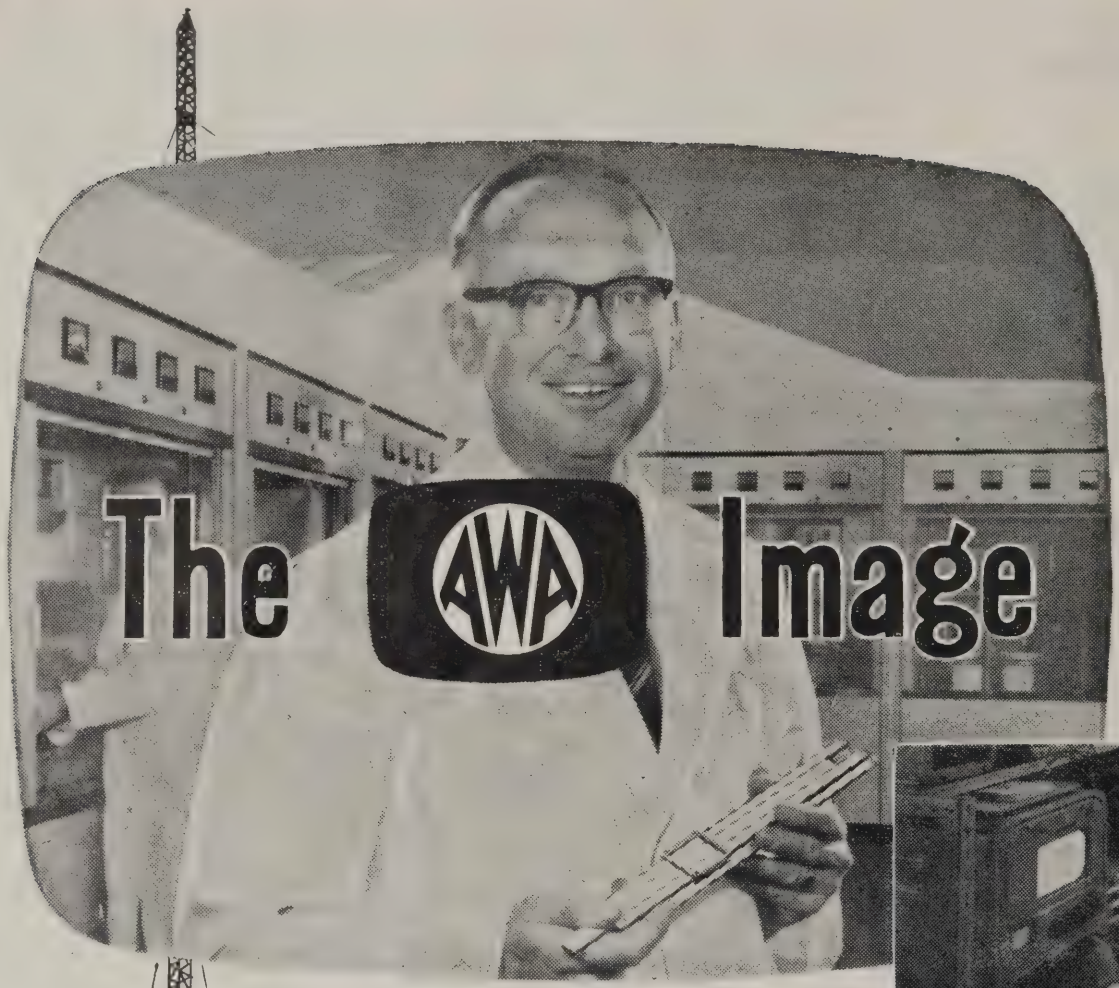

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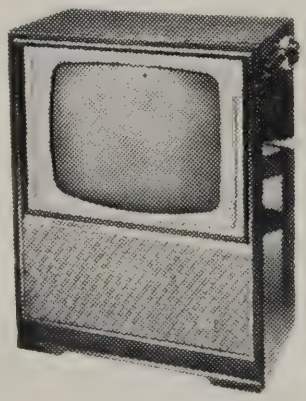

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PARALLEL RESISTANCES BY MENTAL ARITHMETIC

In a letter to the Editor, Mr. S. Leonard-Taylor of Wellington writes:—

This article refers to a short-cut method for rapid calculation of the effective value of two parallel resistances, with sufficient accuracy for many purposes. This can save a great deal of irksome arithmetic, which is especially annoying during the evolution stage of a new electrical or electronic device, where values are being changed frequently. The mathematics involved in deducing this short-cut method are very elementary and yet, strangely enough, I have never ever heard or read of it. I should be interested to learn from you whether the method is known to many, a few or none.

The task of finding the equivalent value of two parallel resistances is ever with us and it would be very useful to have a quick way of working out any values by mental arithmetic, with an error not exceeding 10 per cent.

Take the case where the two resistances are 47K and 120K. By conventional methods we have:—

$$\text{Reff.} = \frac{1}{\frac{1}{47K} + \frac{1}{120K}} = \frac{47K \times 120K}{47K + 120K}$$

and this works out to 34K.

The short-cut method offered goes like this:— 120K is approximately 3 times 47K so reduce the lower resistance by $\frac{1}{3+1}$ i.e. by $\frac{1}{4}$ and this gives the answer. Thus we have 47K minus $\frac{47K}{4}$; equals 47K minus 12K; equals 35K. (Note that the 47K is reduced BY $\frac{1}{4}$, not TO $\frac{1}{4}$.)

THE RULE IS that, if there are two resistances in parallel and the higher one is n times the lower one, then the effective resistance of the pair is equal to that of the lower one reduced by $\frac{1}{n+1}$.

Putting the rule in formula form:—

$$\text{Reff.} = R_1 - \frac{R_1}{n+1}$$

where $n = \frac{R_2}{R_1}$ (Choose R_1 as the smaller of the two resistances.)

This formula is exact as it stands, but the answer is fairly tolerant to approximations in the value of n, so that generally n may be taken to the nearest whole number. Of course n is found by just making a couple of trials to see which is nearer—not by actually dividing R_2 by R_1. The only case where taking n to the nearest whole number will not be good enough is when n is closer to $1\frac{1}{2}$ than it is to 1 or 2. In this case, take n as $1\frac{1}{2}$. Then the lower resistance should be reduced by $\frac{1}{1\frac{1}{2}+1}$ i.e. reduced by two-fifths but it will be easier just to remember that:—

> when n is nearest to $1\frac{1}{2}$ the answer is obtained simply by multiplying the lower resistance by three-fifths.

This method may be used to find what value of resistance must be paralleled across another to reduce the effective value by a given amount. Thus, if it is desired to reduce a given resistance by 10%, we connect across it one of 9 times the size.

The method is also applicable for working out the effective capacity of series connected condensers.

ACCURACY: The following is given to indicate the accuracy obtainable with this short-cut method. The maximum error which can be caused by "rounding off" the n happens when n is just a shade under $1\frac{1}{4}$ in which case it is taken as 1 and the error is just under 10%.

If n lies anywhere between $1\frac{1}{4}$ and $1\frac{3}{4}$ it will be taken as $1\frac{1}{2}$ and the maximum error is 8%.

If n lies between $1\frac{3}{4}$ and $2\frac{1}{2}$ it will be taken as 2 and the maximum error is 6.7%.

As n increases, the error becomes very small so that, if n lies say almost halfway between 4 and 5 and is taken as 4, the error is only about 2%. Referring again to the first worked example, it will be noted that 47K divided by 4 was approximated to give 12K. This sort of thing can, of course, introduce an additional small error but the effect on the answer is obvious at a glance and it could be eliminated, in the few cases where it might matter, by taking the division to one further place.

(One of our technical editors, Mr. I. Spackman, comments that this short-cut method is generally known but is very useful. Mr. Leonard-Taylor has, however, given it a new twist and we have pleasure in printing it in its entirety.—Ed.)

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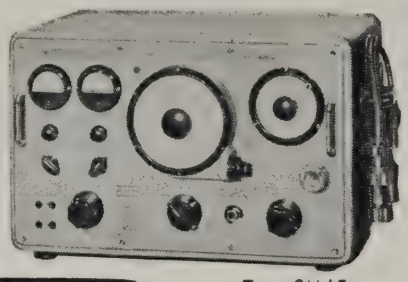

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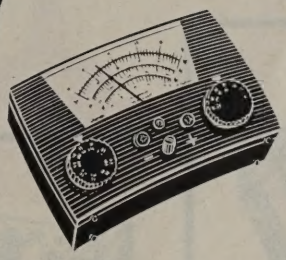

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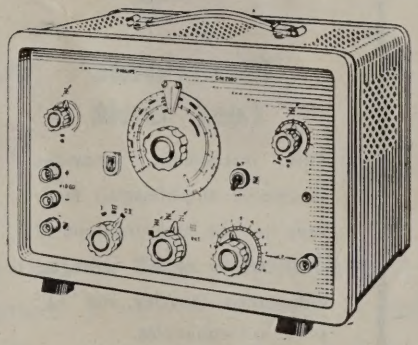

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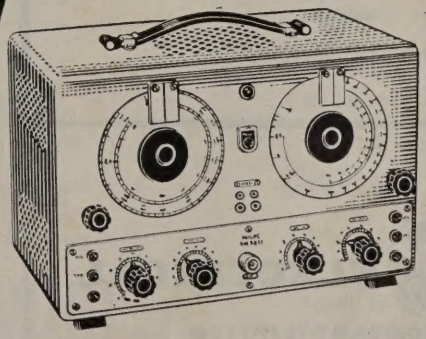

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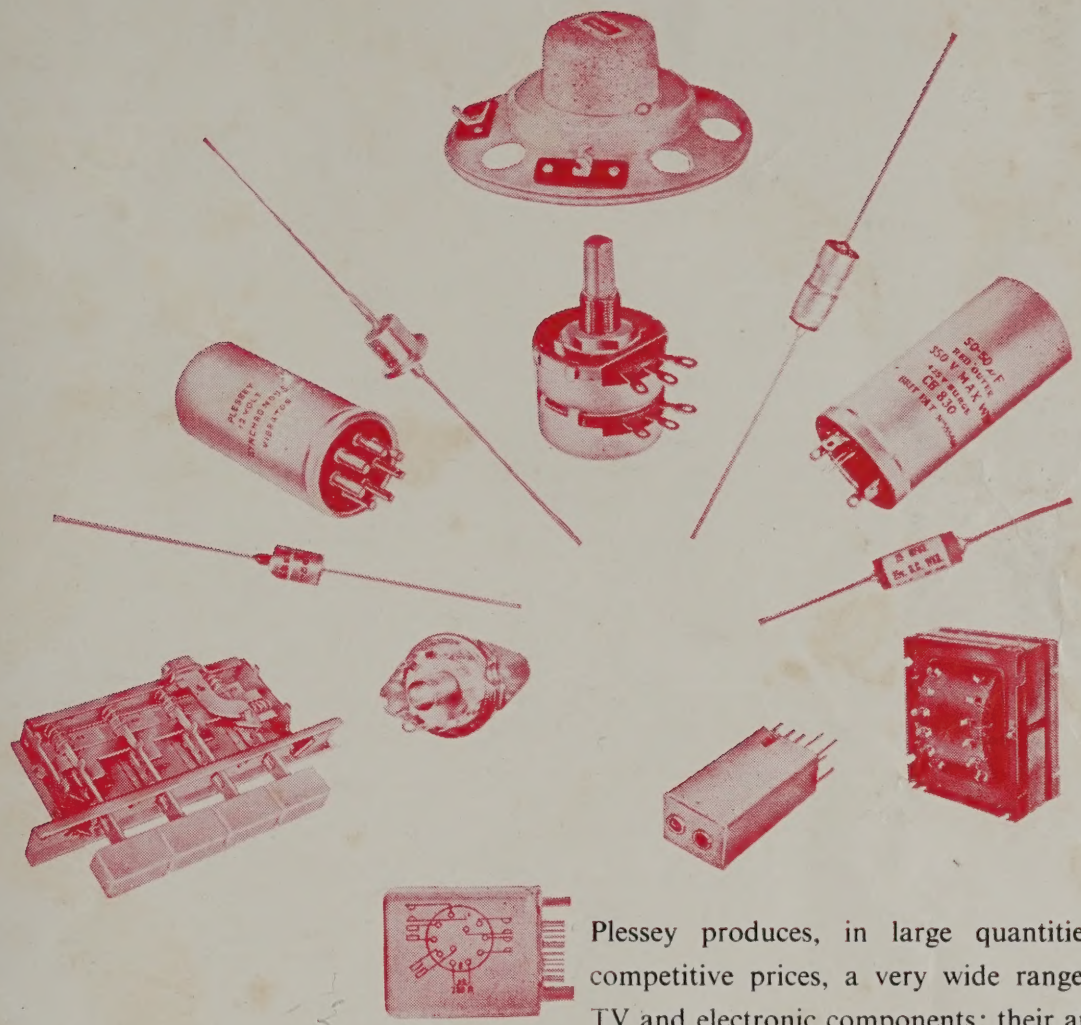

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3″	500/1	150	7/8	600/1	150	8/9	700/2	225	10/3		3/7	
5″	500/6	600	20/3	600/6	600	22/–	700/8	900	34/–		8/–	
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	Type No.	Length (Feet)	Inches per second 1⅞	3¾	7½	15	Type No.	Length (Feet)	Inches per second 1⅞	3¾	7½	15	Type No.	Length (Feet)	Inches per second 1⅞	3¾	7½	15
			Playing time in mins.						Playing time in mins.						Playing time in mins.			
3″	500/1	150	32	16	8	4	600/1	150	32	16	8	4	700/2	225	48	24	12	6
5″	500/6	600	128	64	32	16	600/6	600	128	64	32	16	700/8	900	192	96	48	24
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